# SUSY at Run 2

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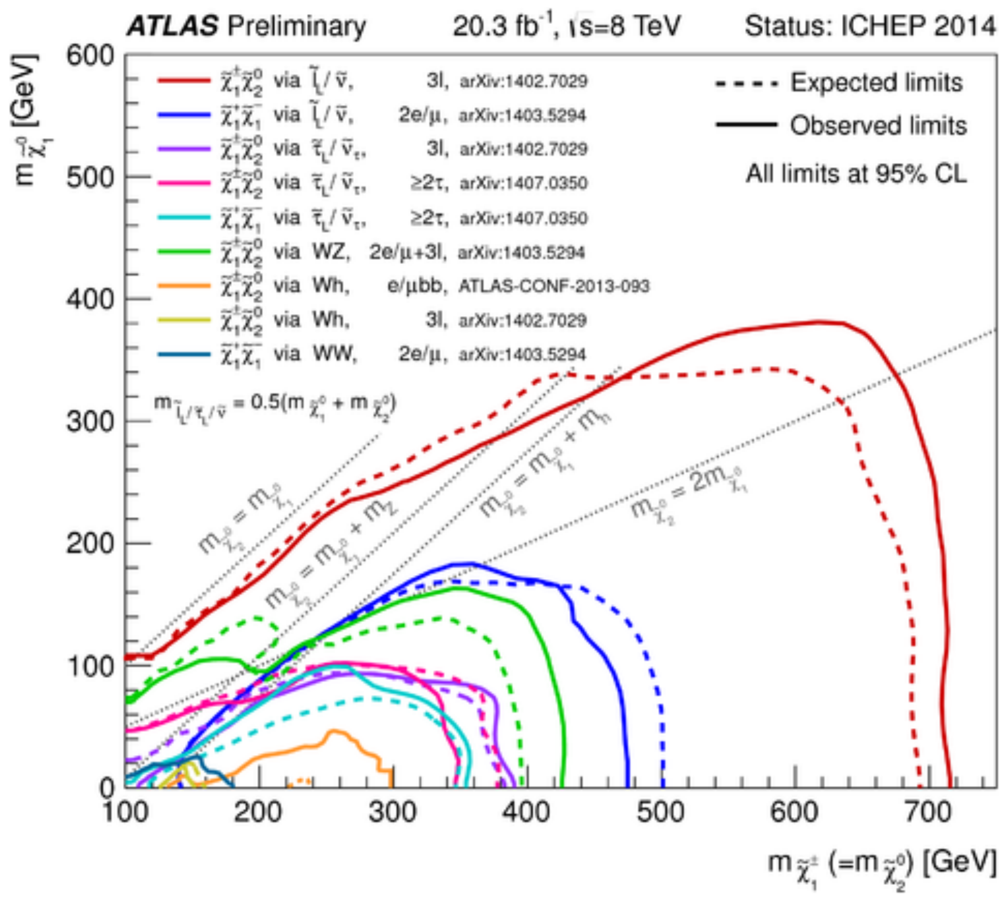
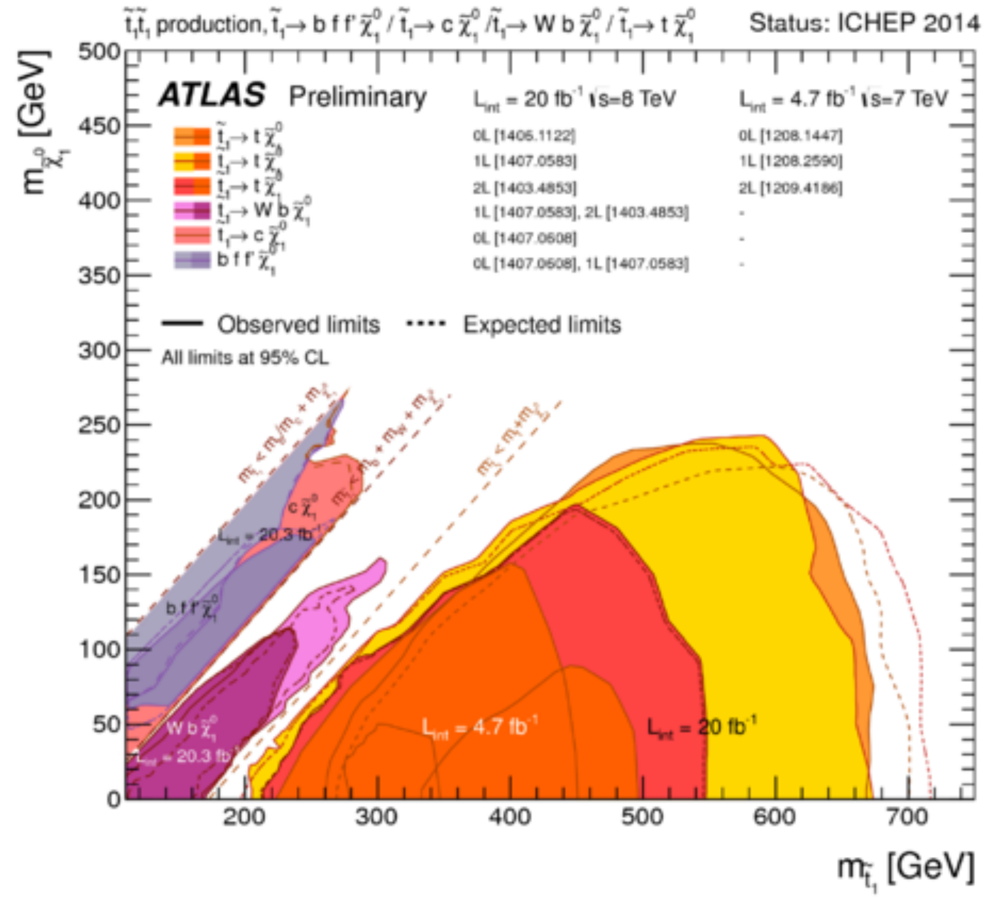
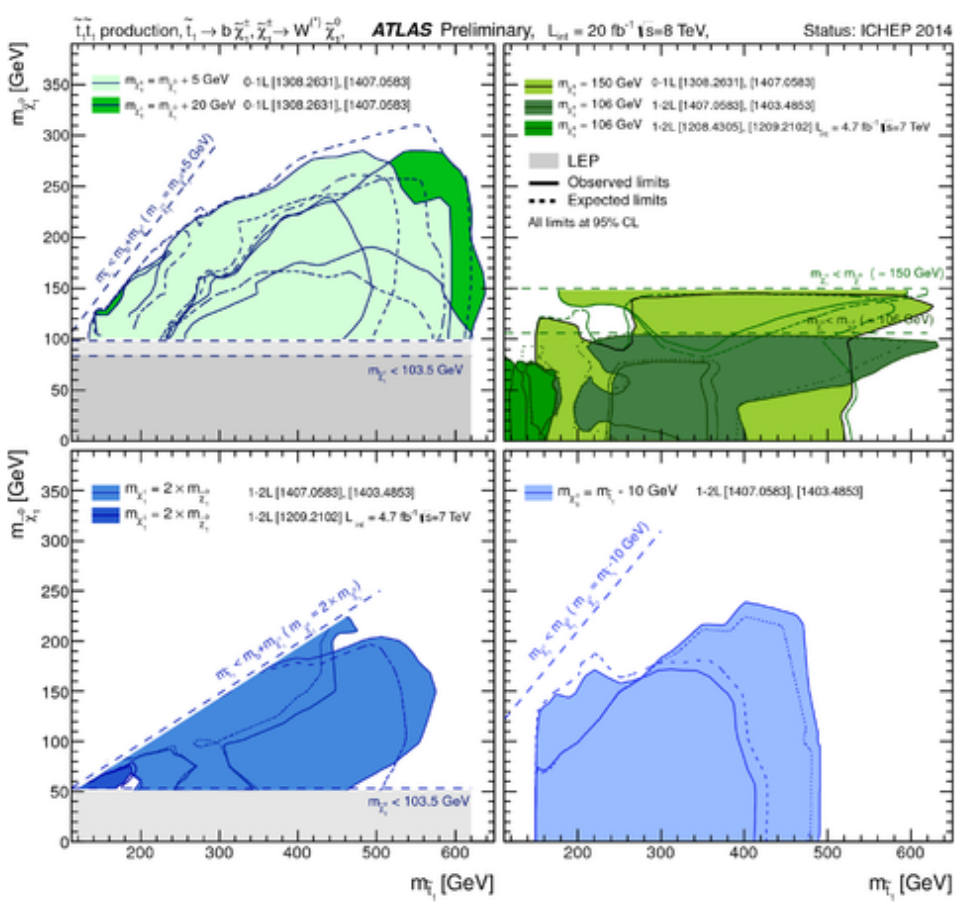
February 12th
10th ATLAS Italy Workshop on Physics and Upgrades

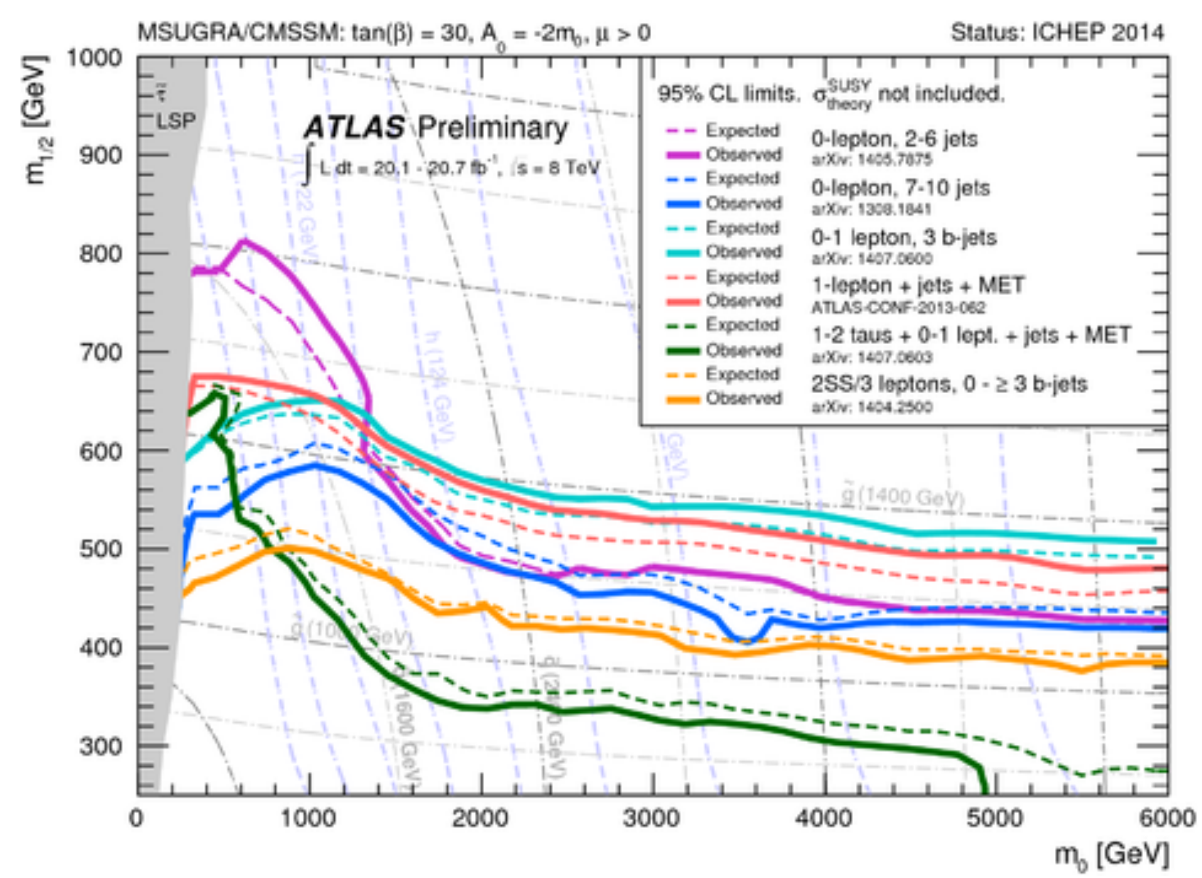
many thanks to Giacomo Polesello for a number of insight

# Simplified (?) Models? … Yes, please



# ATLAS SUSY Searches* - 95% CL Lower Limits

Status: Moriond 2014

**ATLAS** Preliminary

$\int \mathcal{L}\,dt$ = (4.6 - 22.9) fb$^{-1}$ $\sqrt{s}$ = 7, 8 TeV

| | Model | $e, \mu, \tau, \gamma$ | Jets | $E_T^{miss}$ | $\int \mathcal{L}\,dt[fb^{-1}]$ | Mass limit | | | Reference |
|---|---|---|---|---|---|---|---|---|---|
| Inclusive Searches | MSUGRA/CMSSM | 0 | 2-6 jets | Yes | 20.3 | $\tilde{q}, \tilde{g}$ | 1.7 TeV | $m(\tilde{q})=m(\tilde{g})$ | ATLAS-CONF-2013-047 |
| | MSUGRA/CMSSM | 1 $e, \mu$ | 3-6 jets | Yes | 20.3 | $\tilde{g}$ | 1.2 TeV | any $m(\tilde{q})$ | ATLAS-CONF-2013-062 |
| | MSUGRA/CMSSM | 0 | 7-10 jets | Yes | 20.3 | $\tilde{g}$ | 1.1 TeV | any $m(\tilde{q})$ | 1308.1841 |
| | $\tilde{q}\tilde{q}, \tilde{q}\to q\tilde{\chi}_1^0$ | 0 | 2-6 jets | Yes | 20.3 | $\tilde{q}$ | 740 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-047 |
| | $\tilde{g}\tilde{g}, \tilde{g}\to q\bar{q}\tilde{\chi}_1^0$ | 0 | 2-6 jets | Yes | 20.3 | $\tilde{g}$ | 1.3 TeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-047 |
| | $\tilde{g}\tilde{g}, \tilde{g}\to qq\tilde{\chi}_1^\pm\to qqW^\pm\tilde{\chi}_1^0$ | 1 $e, \mu$ | 3-6 jets | Yes | 20.3 | $\tilde{g}$ | 1.18 TeV | $m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^\pm)$=0.5($m(\tilde{\chi}_1^0)$+$m(\tilde{g})$) | ATLAS-CONF-2013-062 |
| | $\tilde{g}\tilde{g}, \tilde{g}\to qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$ | 2 $e, \mu$ | 0-3 jets | - | 20.3 | $\tilde{g}$ | 1.12 TeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-089 |
| | GMSB ($\tilde{\ell}$ NLSP) | 2 $e, \mu$ | 2-4 jets | Yes | 4.7 | $\tilde{g}$ | 1.24 TeV | tan$\beta$<15 | 1208.4688 |
| | GMSB ($\tilde{\ell}$ NLSP) | 1-2 $\tau$ | 0-2 jets | Yes | 20.7 | $\tilde{g}$ | 1.4 TeV | tan$\beta$ >18 | ATLAS-CONF-2013-026 |
| | GGM (bino NLSP) | 2 $\gamma$ | - | Yes | 20.3 | $\tilde{g}$ | 1.28 TeV | $m(\tilde{\chi}_1^0)$>50 GeV | ATLAS-CONF-2014-001 |
| | GGM (wino NLSP) | 1 $e, \mu + \gamma$ | - | Yes | 4.8 | $\tilde{g}$ | 619 GeV | $m(\tilde{\chi}_1^0)$>50 GeV | ATLAS-CONF-2012-144 |
| | GGM (higgsino-bino NLSP) | $\gamma$ | 1 $b$ | Yes | 4.8 | $\tilde{g}$ | 900 GeV | $m(\tilde{\chi}_1^0)$>220 GeV | 1211.1167 |
| | GGM (higgsino NLSP) | 2 $e, \mu$ ($Z$) | 0-3 jets | Yes | 5.8 | $\tilde{g}$ | 690 GeV | $m(\tilde{H})$>200 GeV | ATLAS-CONF-2012-152 |
| | Gravitino LSP | 0 | mono-jet | Yes | 10.5 | $F^{1/2}$ scale | 645 GeV | $m(\tilde{g})>10^{-4}$ eV | ATLAS-CONF-2012-147 |
| $3^{rd}$ gen. $\tilde{g}$ med. | $\tilde{g}\to b\bar{b}\tilde{\chi}_1^0$ | 0 | 3 $b$ | Yes | 20.1 | $\tilde{g}$ | 1.2 TeV | $m(\tilde{\chi}_1^0)$<600 GeV | ATLAS-CONF-2013-061 |
| | $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$ | 0 | 7-10 jets | Yes | 20.3 | $\tilde{g}$ | 1.1 TeV | $m(\tilde{\chi}_1^0)$ <350 GeV | 1308.1841 |
| | $\tilde{g}\to t\bar{t}\tilde{\chi}_1^0$ | 0-1 $e, \mu$ | 3 $b$ | Yes | 20.1 | $\tilde{g}$ | 1.34 TeV | $m(\tilde{\chi}_1^0)$<400 GeV | ATLAS-CONF-2013-061 |
| | $\tilde{g}\to b\bar{t}\tilde{\chi}_1^+$ | 0-1 $e, \mu$ | 3 $b$ | Yes | 20.1 | $\tilde{g}$ | 1.3 TeV | $m(\tilde{\chi}_1^0)$<300 GeV | ATLAS-CONF-2013-061 |
| $3^{rd}$ gen. squarks direct production | $\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to b\tilde{\chi}_1^0$ | 0 | 2 $b$ | Yes | 20.1 | $\tilde{b}_1$ | 100-620 GeV | $m(\tilde{\chi}_1^0)$<90 GeV | 1308.2631 |
| | $\tilde{b}_1\tilde{b}_1, \tilde{b}_1\to t\tilde{\chi}_1^\pm$ | 2 $e, \mu$ (SS) | 0-3 $b$ | Yes | 20.7 | $\tilde{b}_1$ | 275-430 GeV | $m(\tilde{\chi}_1^\pm)$=2 $m(\tilde{\chi}_1^0)$ | ATLAS-CONF-2013-007 |
| | $\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$ | 1-2 $e, \mu$ | 1-2 $b$ | Yes | 4.7 | $\tilde{t}_1$ | 110-167 GeV | $m(\tilde{\chi}_1^0)$=55 GeV | 1208.4305, 1209.2102 |
| | $\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\to Wb\tilde{\chi}_1^0$ | 2 $e, \mu$ | 0-2 jets | Yes | 20.3 | $\tilde{t}_1$ | 130-210 GeV | $m(\tilde{\chi}_1^0)$ =$m(\tilde{t}_1)$-$m(W)$-50 GeV, $m(\tilde{t}_1)$<<$m(\tilde{\chi}_1^\pm)$ | 1403.4853 |
| | $\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to t\tilde{\chi}_1^0$ | 2 $e, \mu$ | 2 jets | Yes | 20.3 | $\tilde{t}_1$ | 215-530 GeV | $m(\tilde{\chi}_1^0)$=1 GeV | 1403.4853 |
| | $\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\to b\tilde{\chi}_1^\pm$ | 0 | 2 $b$ | Yes | 20.1 | $\tilde{t}_1$ | 150-580 GeV | $m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}_1^\pm)$-$m(\tilde{\chi}_1^0)$=5 GeV | 1308.2631 |
| | $\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$ | 1 $e, \mu$ | 1 $b$ | Yes | 20.7 | $\tilde{t}_1$ | 200-610 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-037 |
| | $\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\to t\tilde{\chi}_1^0$ | 0 | 2 $b$ | Yes | 20.5 | $\tilde{t}_1$ | 320-660 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | ATLAS-CONF-2013-024 |
| | $\tilde{t}_1\tilde{t}_1, \tilde{t}_1\to c\tilde{\chi}_1^0$ | 0 | mono-jet/$c$-tag | Yes | 20.3 | $\tilde{t}_1$ | 90-200 GeV | $m(\tilde{t}_1)$-$m(\tilde{\chi}_1^0)$<85 GeV | ATLAS-CONF-2013-068 |
| | $\tilde{t}_1\tilde{t}_1$(natural GMSB) | 2 $e, \mu$ ($Z$) | 1 $b$ | Yes | 20.3 | $\tilde{t}_1$ | 150-580 GeV | $m(\tilde{\chi}_1^0)$>150 GeV | 1403.5222 |
| | $\tilde{t}_2\tilde{t}_2, \tilde{t}_2\to\tilde{t}_1 + Z$ | 3 $e, \mu$ ($Z$) | 1 $b$ | Yes | 20.3 | $\tilde{t}_2$ | 290-600 GeV | $m(\tilde{\chi}_1^0)$<200 GeV | 1403.5222 |
| EW direct | $\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\to\ell\tilde{\chi}_1^0$ | 2 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\ell}$ | 90-325 GeV | $m(\tilde{\chi}_1^0)$=0 GeV | 1403.5294 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\ell}\nu(\ell\tilde{\nu})$ | 2 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\chi}_1^\pm$ | 140-465 GeV | $m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\ell},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | 1403.5294 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to\tilde{\tau}\nu(\tau\tilde{\nu})$ | 2 $\tau$ | - | Yes | 20.7 | $\tilde{\chi}_1^\pm$ | 180-330 GeV | $m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | ATLAS-CONF-2013-028 |
| | $\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$ | 3 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ | 700 GeV | $m(\tilde{\chi}_1^\pm)$=$m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $m(\tilde{\ell},\tilde{\nu})$=0.5($m(\tilde{\chi}_1^\pm)$+$m(\tilde{\chi}_1^0)$) | 1402.7029 |
| | $\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 Z\tilde{\chi}_1^0$ | 2-3 $e, \mu$ | 0 | Yes | 20.3 | $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ | 420 GeV | $m(\tilde{\chi}_1^\pm)$=$m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled | 1403.5294, 1402.7029 |
| | $\tilde{\chi}_1^\pm\tilde{\chi}_2^0\to W\tilde{\chi}_1^0 h\tilde{\chi}_1^0$ | 1 $e, \mu$ | 2 $b$ | Yes | 20.3 | $\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$ | 285 GeV | $m(\tilde{\chi}_1^\pm)$=$m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled | ATLAS-CONF-2013-093 |
| Long-lived particles | Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$ | Disapp. trk | 1 jet | Yes | 20.3 | $\tilde{\chi}_1^\pm$ | 270 GeV | $m(\tilde{\chi}_1^\pm)$-$m(\tilde{\chi}_1^0)$=160 MeV, $\tau(\tilde{\chi}_1^\pm)$=0.2 ns | ATLAS-CONF-2013-069 |
| | Stable, stopped $\tilde{g}$ R-hadron | 0 | 1-5 jets | Yes | 22.9 | $\tilde{g}$ | 832 GeV | $m(\tilde{\chi}_1^0)$=100 GeV, 10 $\mu$s<$\tau(\tilde{g})$<1000 s | ATLAS-CONF-2013-057 |
| | GMSB, stable $\tilde{\tau}, \tilde{\chi}_1^0\to\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$ | 1-2 $\mu$ | - | - | 15.9 | $\tilde{\chi}_1^0$ | 475 GeV | 10<tan$\beta$<50 | ATLAS-CONF-2013-058 |
| | GMSB, $\tilde{\chi}_1^0\to\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$ | 2 $\gamma$ | - | Yes | 4.7 | $\tilde{\chi}_1^0$ | 230 GeV | 0.4<$\tau(\tilde{\chi}_1^0)$<2 ns | 1304.6310 |
| | $\tilde{q}\tilde{q}, \tilde{\chi}_1^0\to qq\mu$ (RPV) | 1 $\mu$, displ. vtx | - | - | 20.3 | $\tilde{q}$ | 1.0 TeV | 1.5 <$c\tau$<156 mm, BR($\mu$)=1, $m(\tilde{\chi}_1^0)$=108 GeV | ATLAS-CONF-2013-092 |
| RPV | LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e + \mu$ | 2 $e, \mu$ | - | - | 4.6 | $\tilde{\nu}_\tau$ | 1.61 TeV | $\lambda'_{311}$=0.10, $\lambda_{132}$=0.05 | 1212.1272 |
| | LFV $pp\to\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\to e(\mu) + \tau$ | 1 $e, \mu + \tau$ | - | - | 4.6 | $\tilde{\nu}_\tau$ | 1.1 TeV | $\lambda'_{311}$=0.10, $\lambda_{1(2)33}$=0.05 | 1212.1272 |
| | Bilinear RPV CMSSM | 1 $e, \mu$ | 7 jets | Yes | 4.7 | $\tilde{q}, \tilde{g}$ | 1.2 TeV | $m(\tilde{q})$=$m(\tilde{g})$, $c\tau_{LSP}$<1 mm | ATLAS-CONF-2012-140 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$ | 4 $e, \mu$ | - | Yes | 20.7 | $\tilde{\chi}_1^\pm$ | 760 GeV | $m(\tilde{\chi}_1^0)$>300 GeV, $\lambda_{121}$>0 | ATLAS-CONF-2013-036 |
| | $\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\to W\tilde{\chi}_1^0, \tilde{\chi}_1^0\to\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$ | 3 $e, \mu + \tau$ | - | Yes | 20.7 | $\tilde{\chi}_1^\pm$ | 350 GeV | $m(\tilde{\chi}_1^0)$>80 GeV, $\lambda_{133}$>0 | ATLAS-CONF-2013-036 |
| | $\tilde{g}\to qqq$ | 0 | 6-7 jets | - | 20.3 | $\tilde{g}$ | 916 GeV | BR($t$)=BR($b$)=BR($c$)=0% | ATLAS-CONF-2013-091 |
| | $\tilde{g}\to\tilde{t}_1 t, \tilde{t}_1\to bs$ | 2 $e, \mu$ (SS) | 0-3 $b$ | Yes | 20.7 | $\tilde{g}$ | 880 GeV | | ATLAS-CONF-2013-007 |
| Other | Scalar gluon pair, sgluon$\to q\bar{q}$ | 0 | 4 jets | - | 4.6 | sgluon | 100-287 GeV | incl. limit from 1110.2693 | 1210.4826 |
| | Scalar gluon pair, sgluon$\to t\bar{t}$ | 2 $e, \mu$ (SS) | 2 $b$ | Yes | 14.3 | sgluon | 350-800 GeV | | ATLAS-CONF-2013-051 |
| | WIMP interaction (D5, Dirac $\chi$) | 0 | mono-jet | Yes | 10.5 | M* scale | 704 GeV | $m(\chi)$<80 GeV, limit of<687 GeV for D8 | ATLAS-CONF-2012-147 |

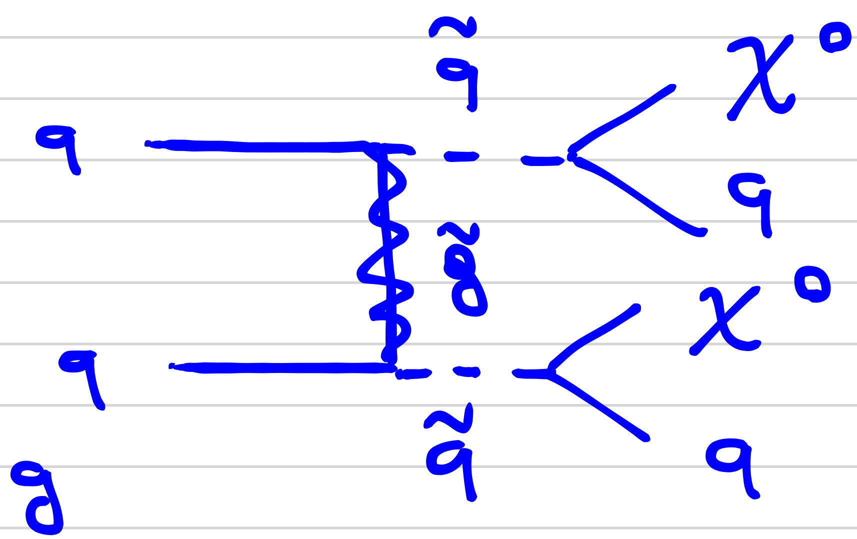
$10^{-1}$ 1 Mass scale [TeV]

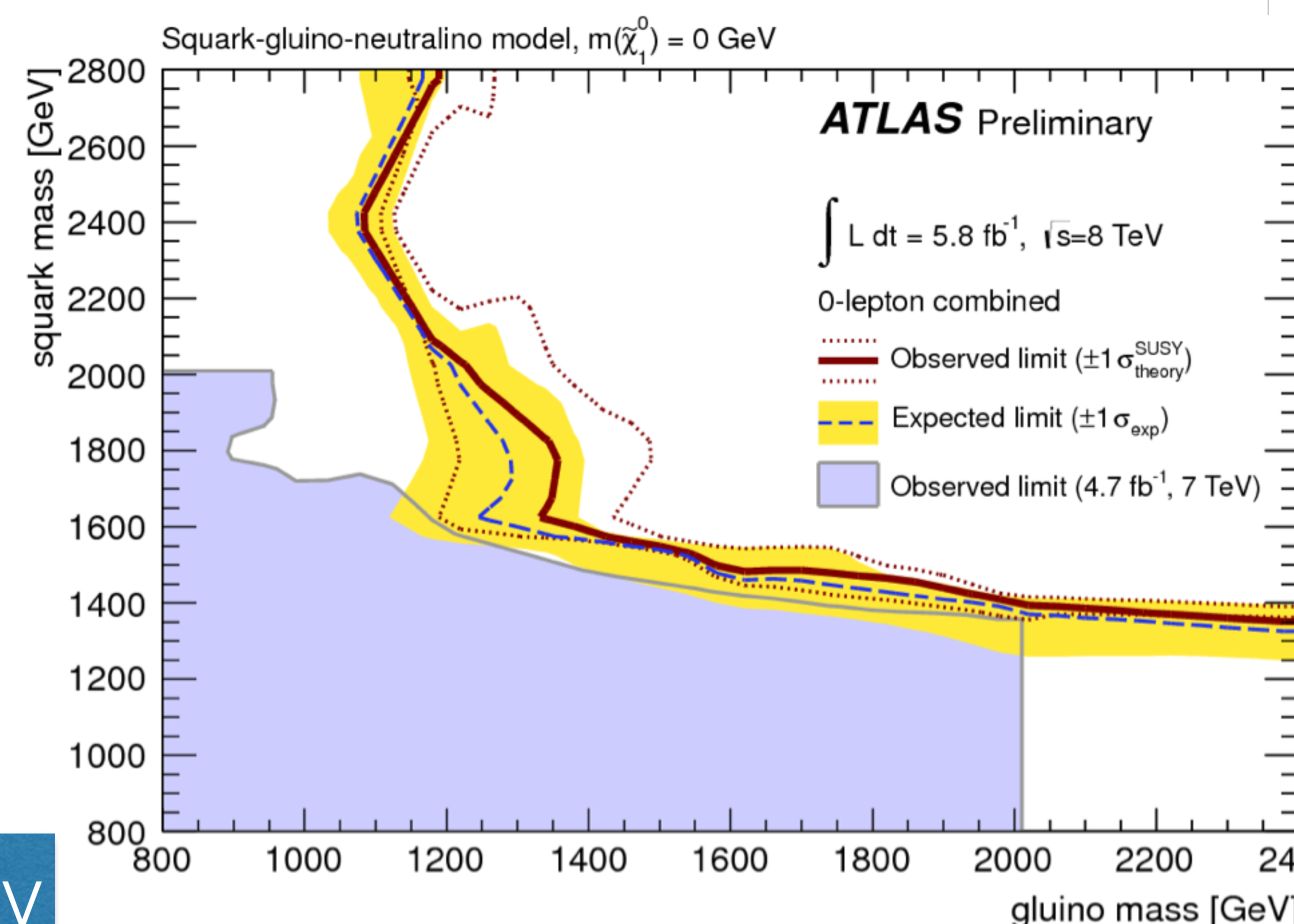
$\sqrt{s}$ = 7 TeV full data | $\sqrt{s}$ = 8 TeV partial data | $\sqrt{s}$ = 8 TeV full data

# NO SIGNAL FROM SUPERPARTNERS

SEARCHES IN FINAL STATES jets + leptons + photons + $\boxed{\text{mET}}$

MISSING TRANSVERE ENERGY IS ASSUMED FROM THE PRODUCTION OF $\boxed{\text{INVISIBLE } \chi^0}$




Stable particle via ad-hoc symmetry

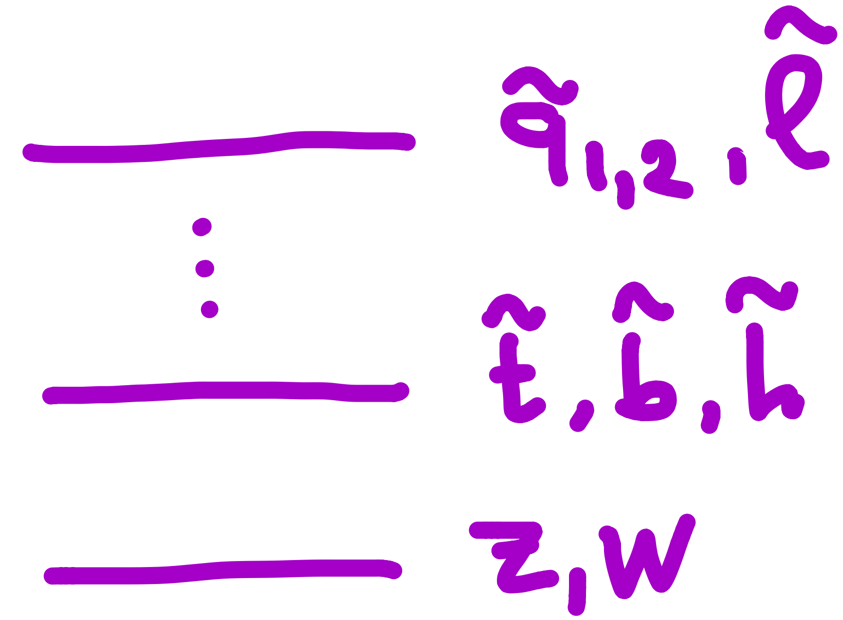
$\boxed{\chi^0 \text{ IS THE DM CANDIDATE}}$

$M_{SUSY} > \text{TeV}$

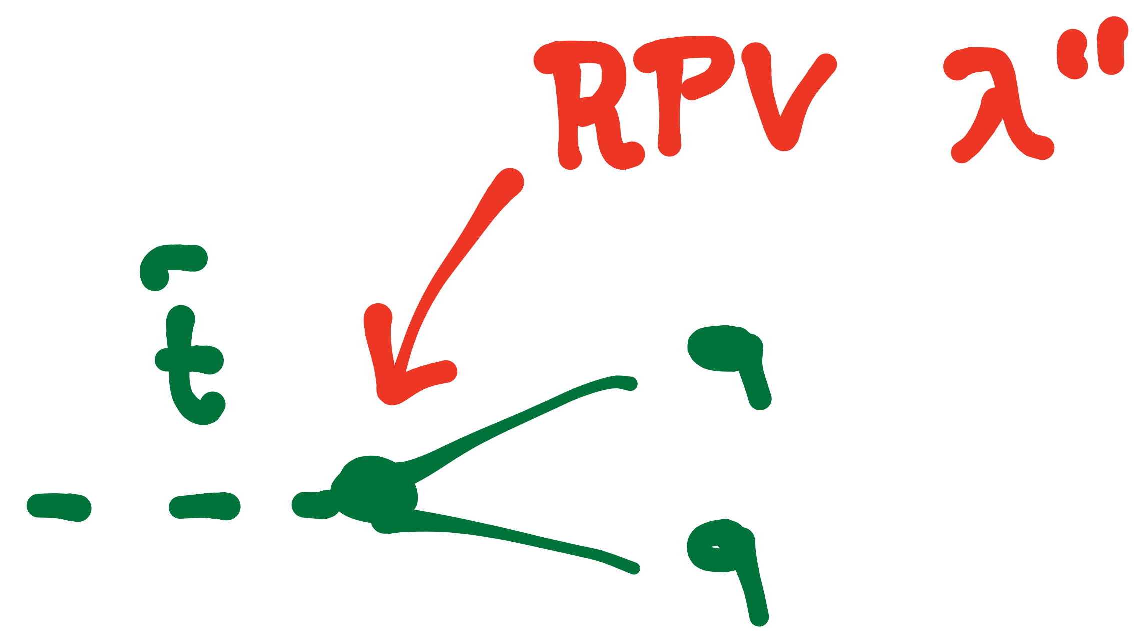
To a very large extent this was the

*Search for supersymmetric dark matter in the decay of colored superpartners*

# Theory Options






at this stage all worth your consideration

some of them talk to the issue $m_h$=126 GeV >> MSSM

# Run2 = Subtle SUSY

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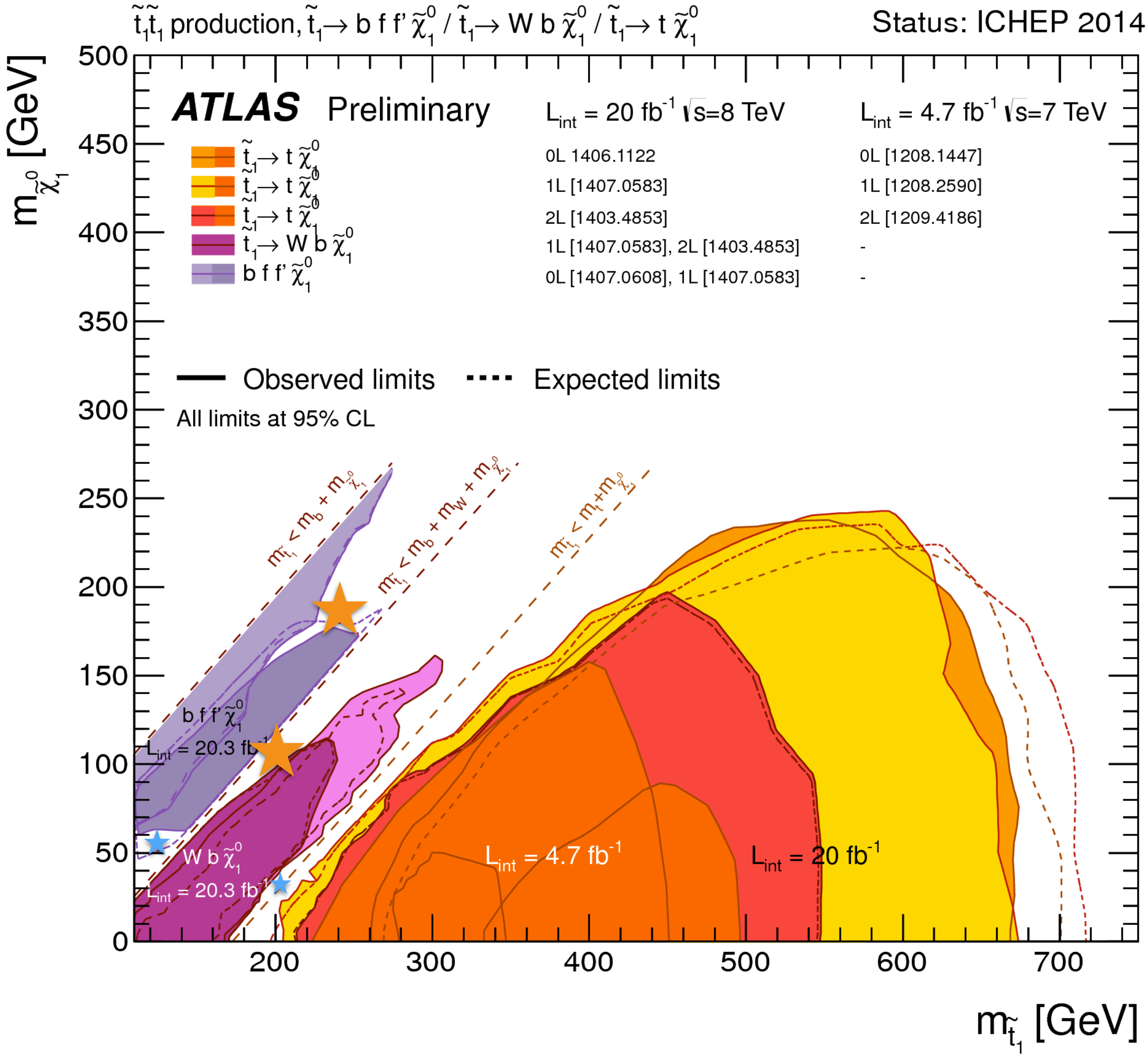
- low cross-section
- low acceptance
- low S/B

- electroweak
- soft objects
- new physics in precision SM

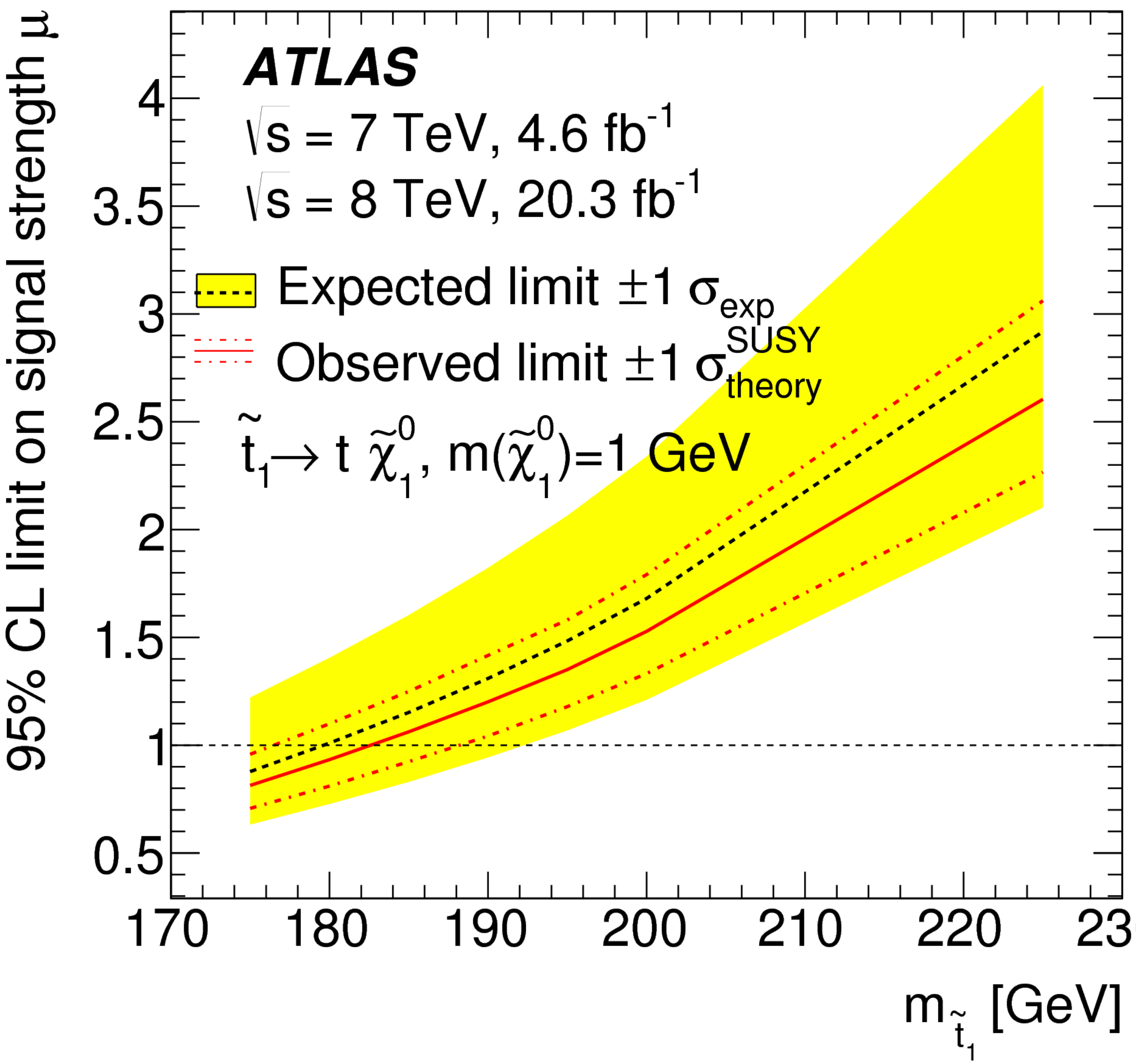


$\tilde{t}_1\tilde{t}_1$ production, $\tilde{t}_1 \to b f f' \tilde{\chi}_1^0$ / $\tilde{t}_1 \to W b \tilde{\chi}_1^0$ / $\tilde{t}_1 \to t \tilde{\chi}_1^0$
Status: ICHEP 2014
ATLAS Preliminary
$L_{int}$ = 20 fb$^{-1}$ $\sqrt{s}$=8 TeV
$L_{int}$ = 4.7 fb$^{-1}$ $\sqrt{s}$=7 TeV
$\tilde{t}_1 \to t \tilde{\chi}_1^0$ 0L 1406.1122 0L [1208.1447]
$\tilde{t}_1 \to t \tilde{\chi}_1^0$ 1L [1407.0583] 1L [1208.2590]
$\tilde{t}_1 \to t \tilde{\chi}_1^0$ 2L [1403.4853] 2L [1209.4186]
$\tilde{t}_1 \to W b \tilde{\chi}_1^0$ 1L [1407.0583], 2L [1403.4853] -
$b f f' \tilde{\chi}_1^0$ 0L [1407.0608], 1L [1407.0583] -
Observed limits
Expected limits
All limits at 95% CL
$m_{\tilde{t}_1} < m_b + m_{\tilde{\chi}_1^0}$
$m_{\tilde{t}_1} < m_b + m_W + m_{\tilde{\chi}_1^0}$
$m_{\tilde{t}_1} < m_t + m_{\tilde{\chi}_1^0}$
$b f f' \tilde{\chi}_1^0$
$L_{int}$ = 20.3 fb$^{-1}$
$W b \tilde{\chi}_1^0$
$L_{int}$ = 20.3 fb$^{-1}$
$L_{int}$ = 4.7 fb$^{-1}$
$L_{int}$ = 20 fb$^{-1}$
$m_{\tilde{\chi}_1^0}$ [GeV]
$m_{\tilde{t}_1}$ [GeV]
0
50
100
150
200
250
300
350
400
450
500
200
300
400
500
600
700

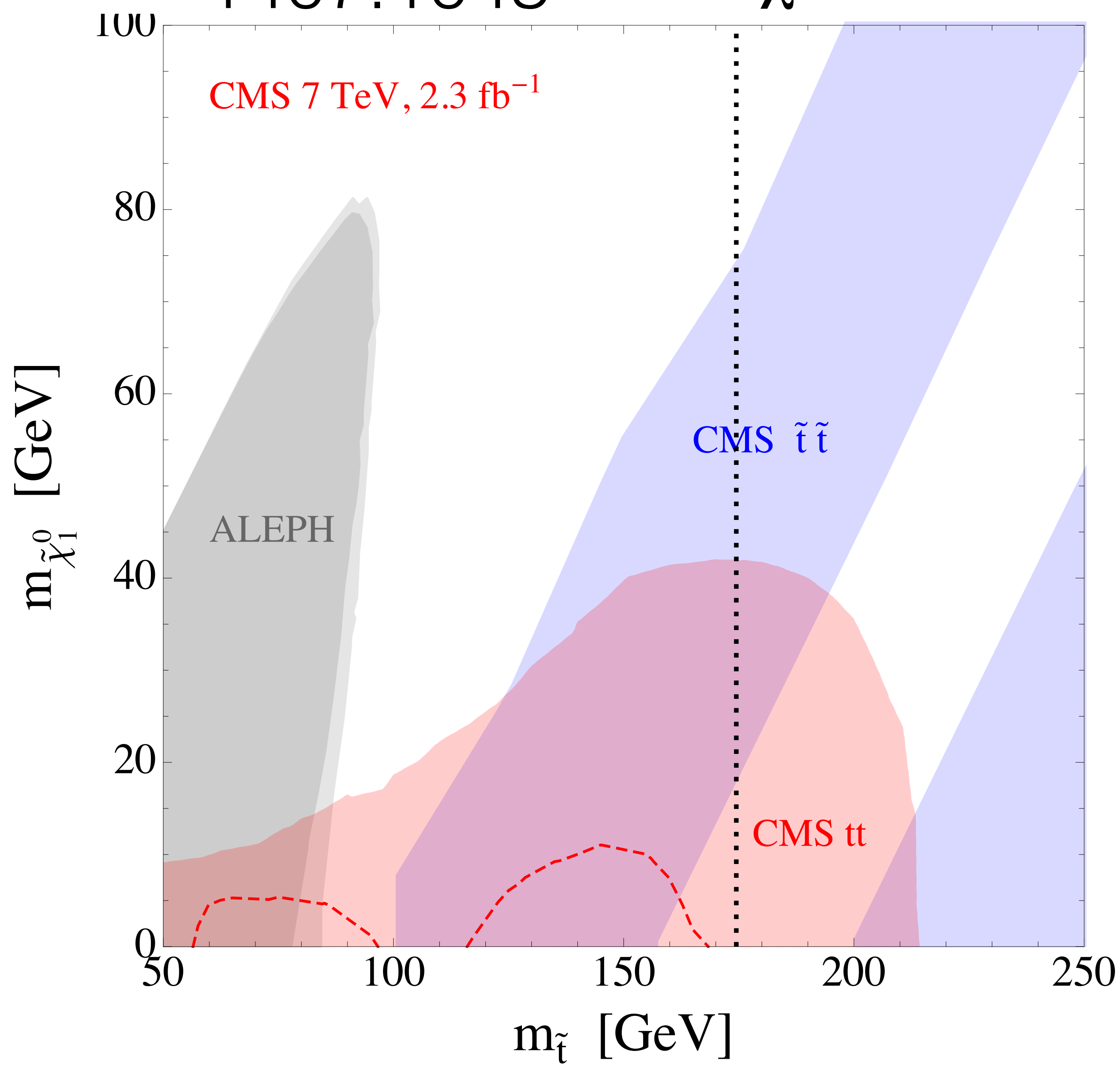
# Precision SUSY-top

light stop effects on top cross-section

1406.5375



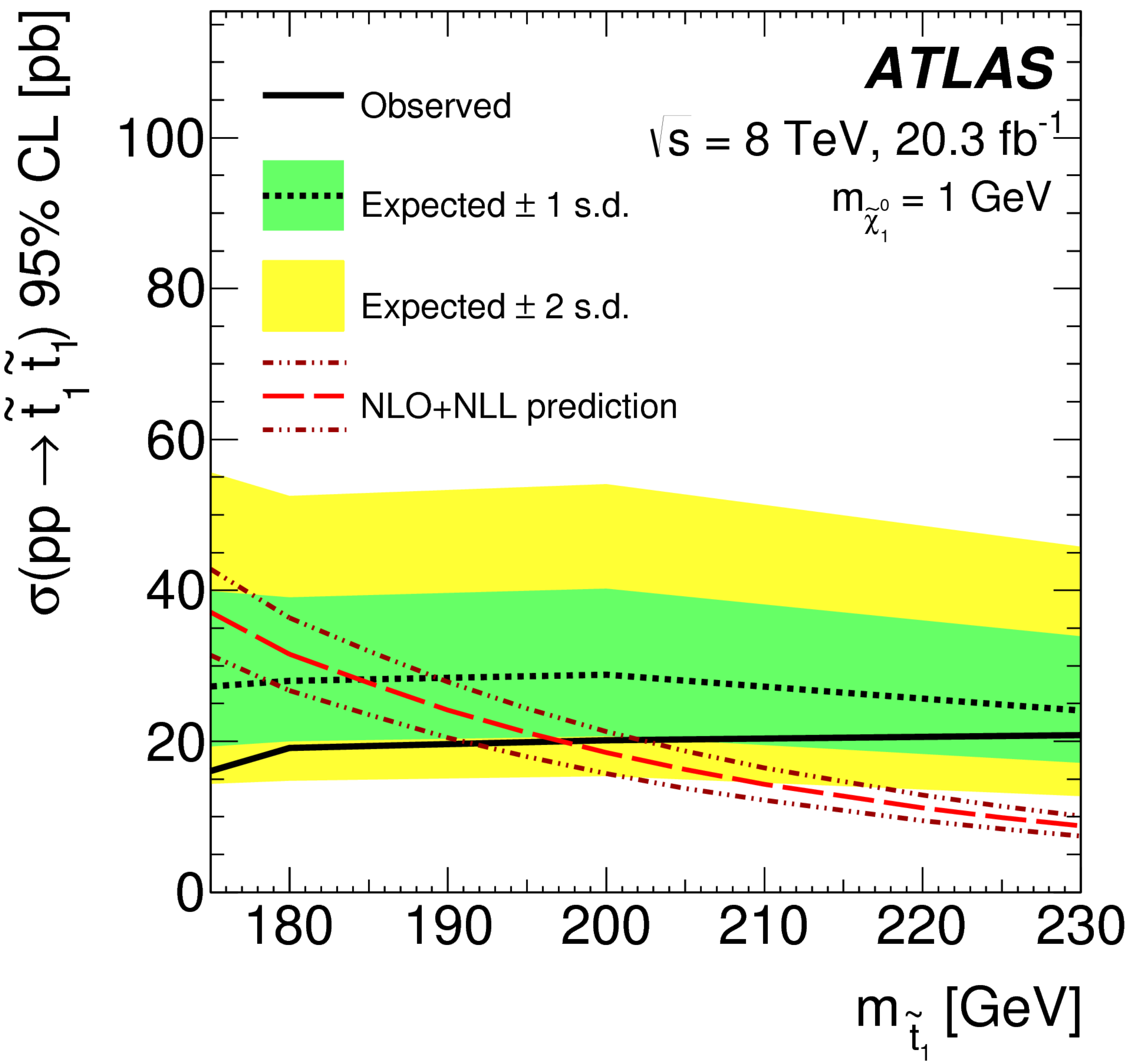

1407.1043 $m\chi \neq 1$ GeV




effects on top mass? 1410.7025

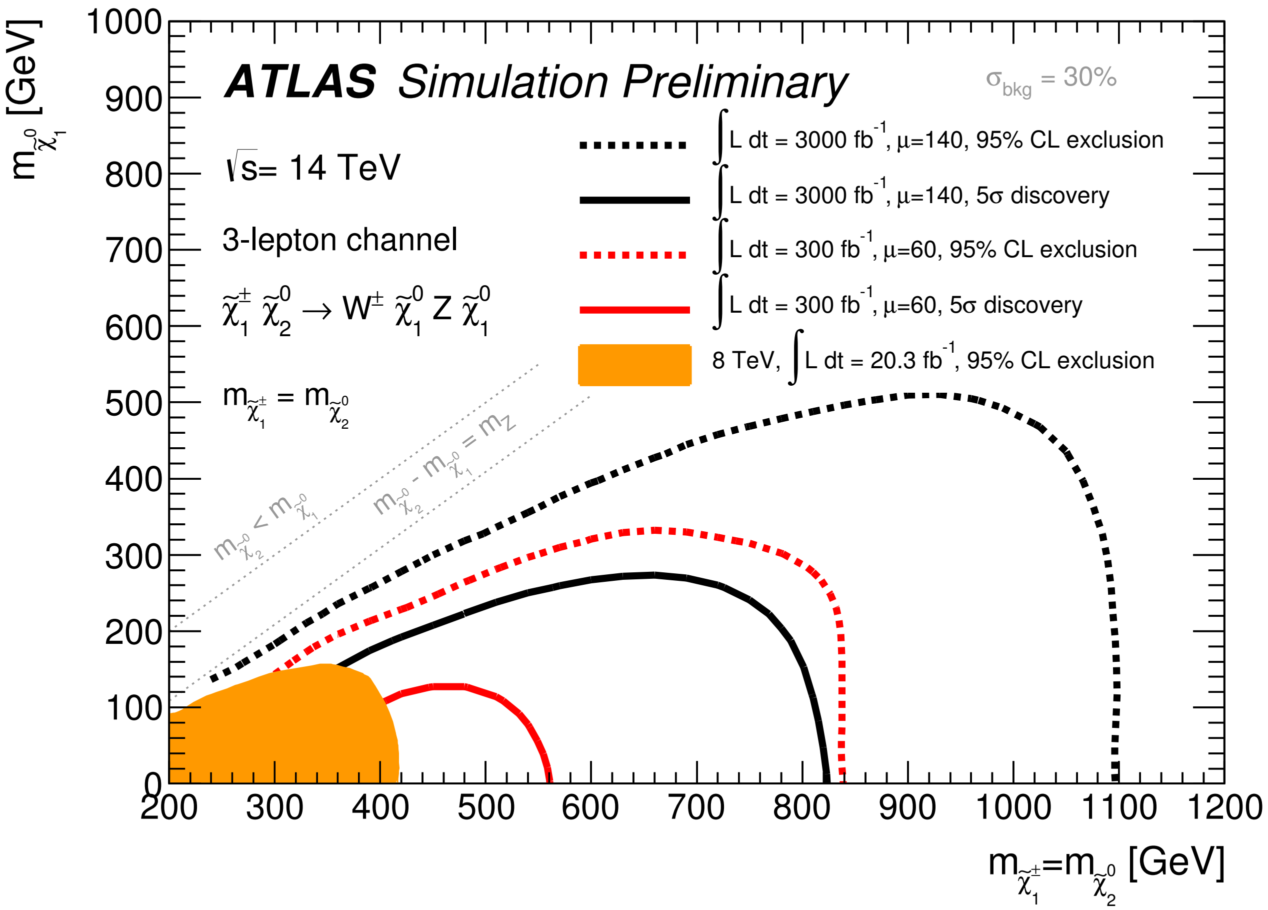
# Precision SUSY-top

light stop effects on $\Delta\phi(\ell\ell)$




- $m\chi \neq 1$ GeV
- variations

unfolded precision distributions?



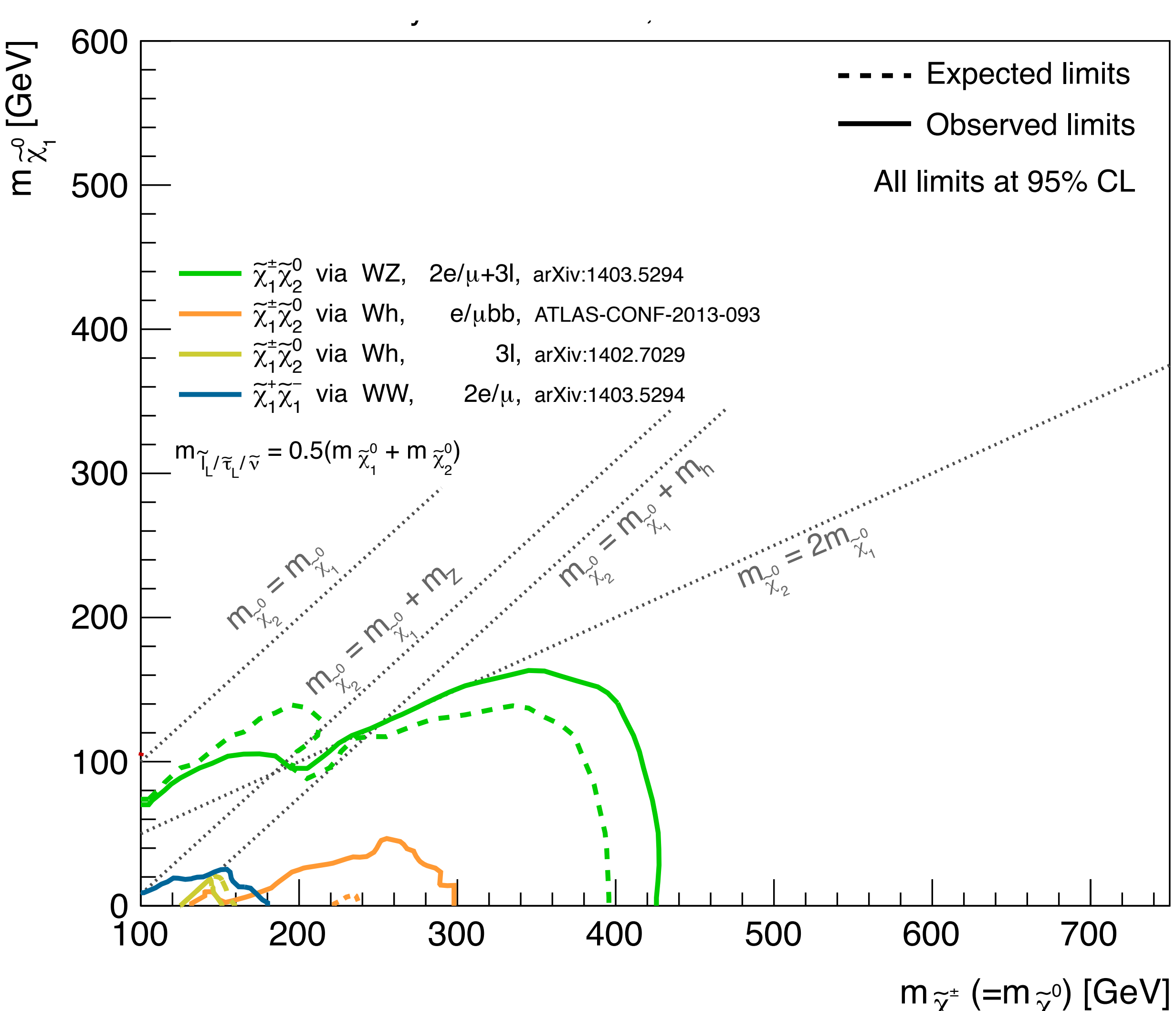

## electroweak signals

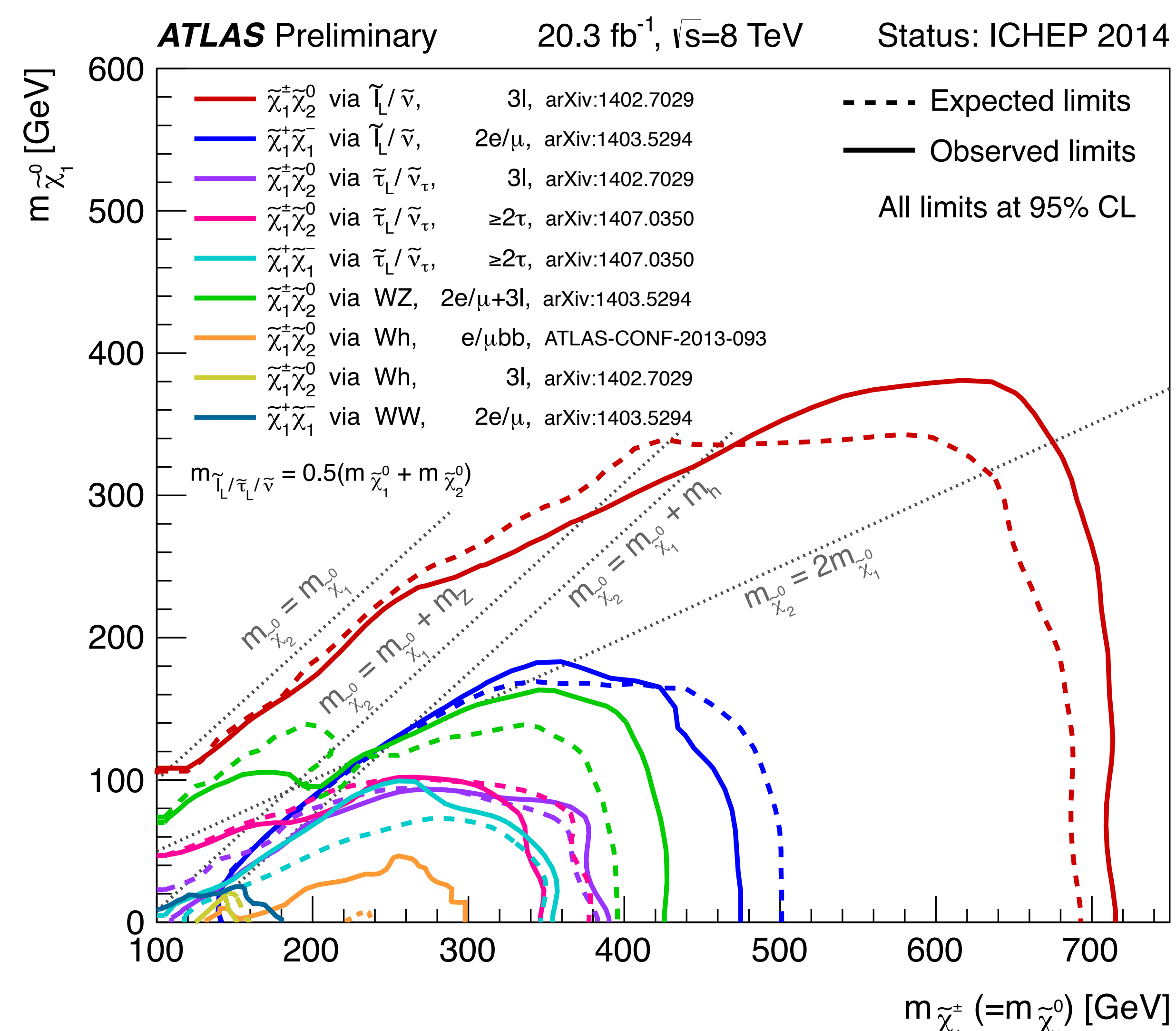
$\ell\ell\ell$+X

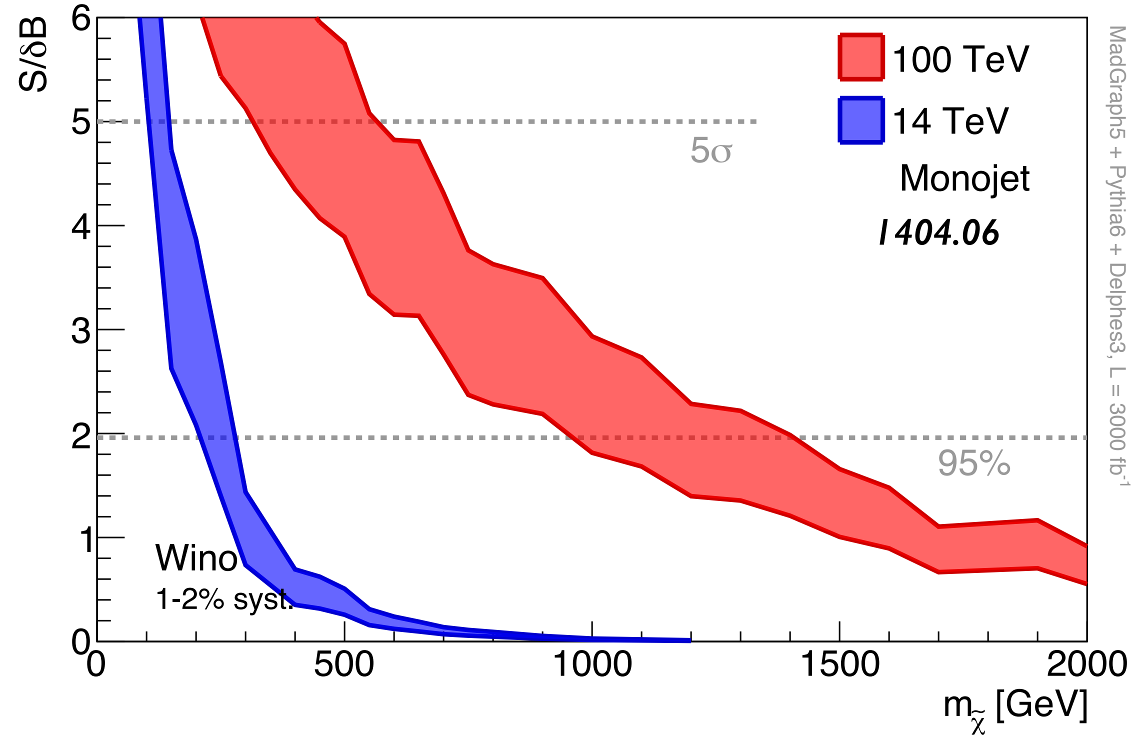
$\ell\ell$+h,Z,γ

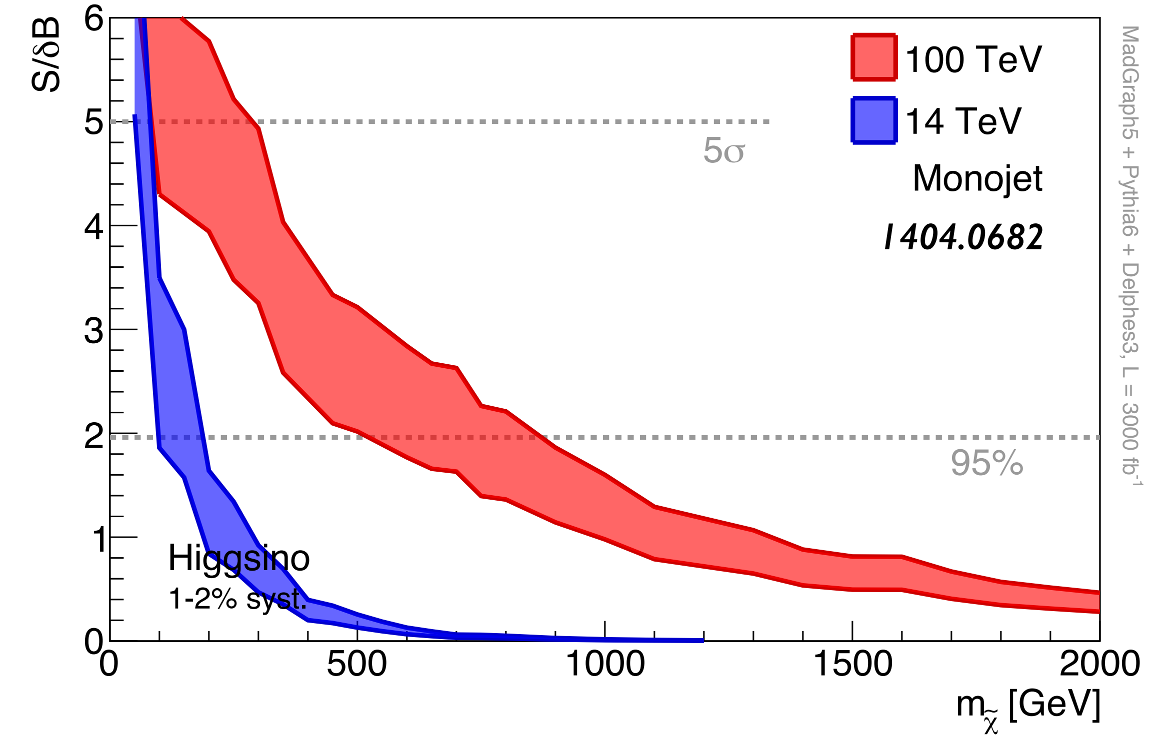
mono-X (X=γ,j,Z,h,t,b, …)

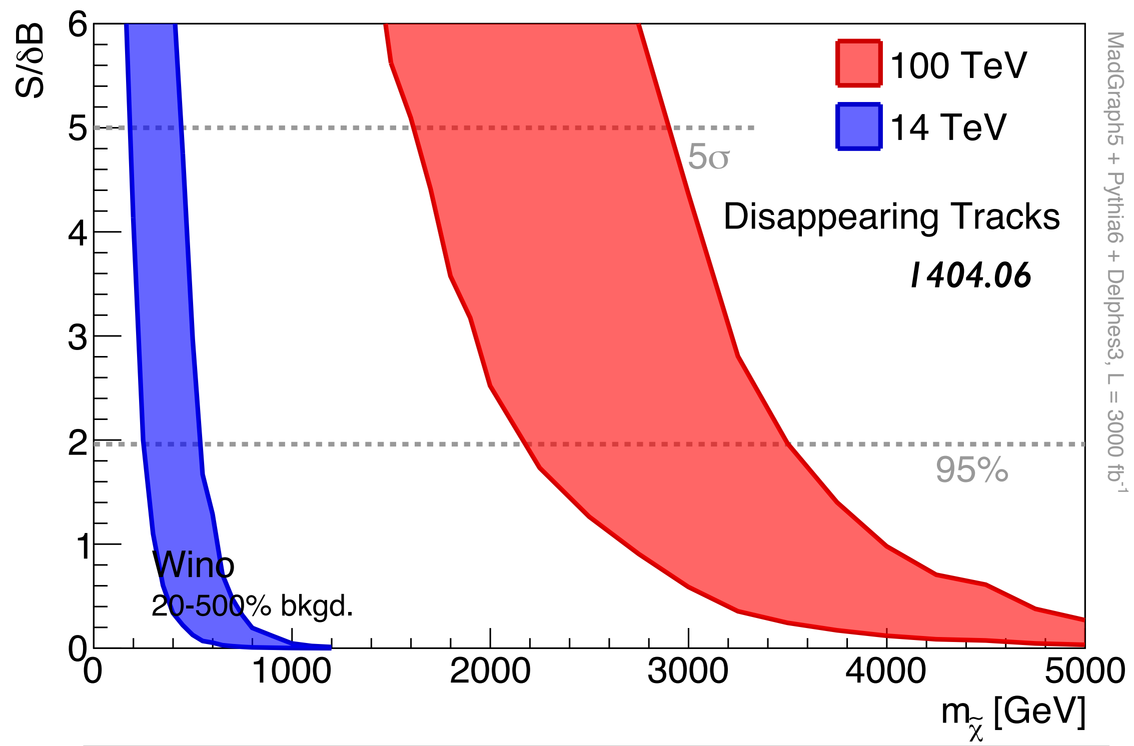
stub-tracks

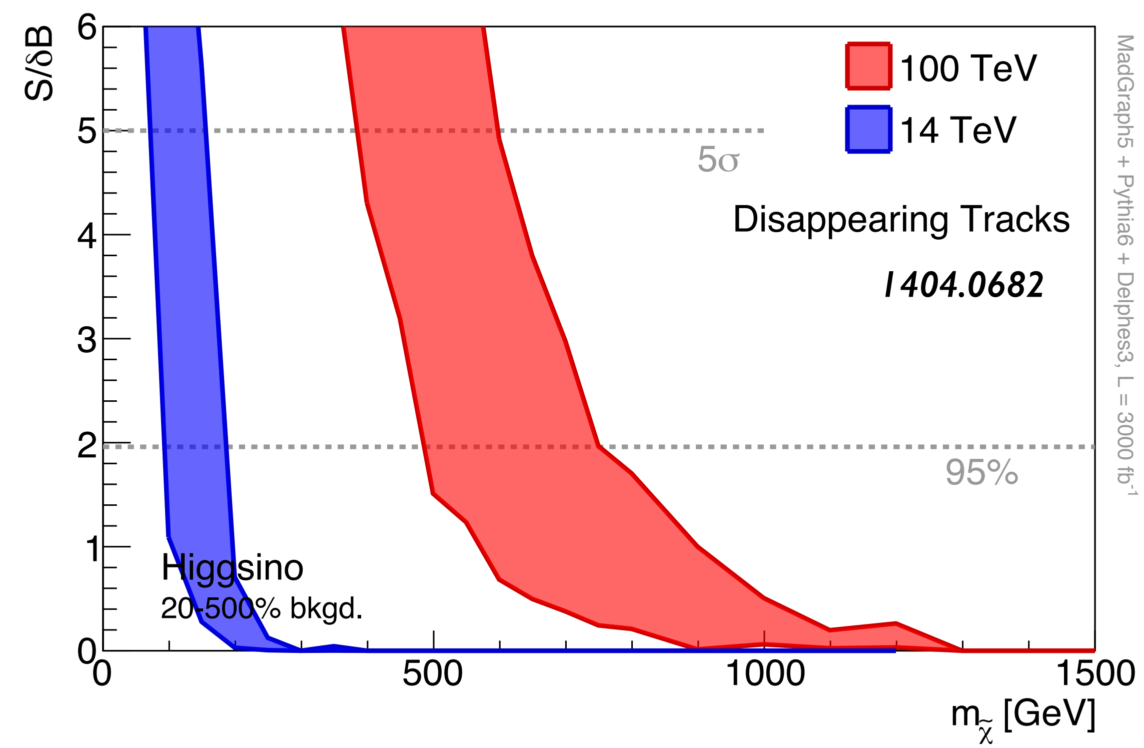





| channel | systematics/ normalization | 14 TeV | | 100 TeV | |
|---|---|---|---|---|---|
| | | 95% limit | 5σ discovery | 95% limit | 5σ discovery |
| monojet | 1% | 280 GeV | 140 GeV | 1.4 TeV | 560 GeV |
| | 2% | 205 GeV | 100 GeV | 960 GeV | 310 GeV |
| disappearing tracks | 500% | 250 GeV | 180 GeV | 2.1 TeV | 1.6 TeV |
| | 100% | 385 GeV | 295 GeV | 2.9 TeV | 2.2 TeV |
| | 20% | 535 GeV | 440 GeV | 3.5 TeV | 2.9 TeV |

| channel | systematics/ normalization | 14 TeV | | 100 TeV | |
|---|---|---|---|---|---|
| | | 95% limit | 5σ discovery | 95% limit | 5σ discovery |
| monojet | 1% | 185 GeV | 80 GeV | 870 GeV | 285 GeV |
| | 2% | 95 GeV | 50 GeV | 580 GeV | 80 GeV |
| disappearing tracks | 20% | 185 GeV | 155 GeV | 750 GeV | 595 GeV |
| | 100% | 140 GeV | 95 GeV | 615 GeV | 485 GeV |
| | 500% | 90 GeV | 70 GeV | 485 GeV | 380 GeV |

# Dark Matter Searches will progress in the same time-scale

# SUSY as a "signatures generator"

# Let it go …

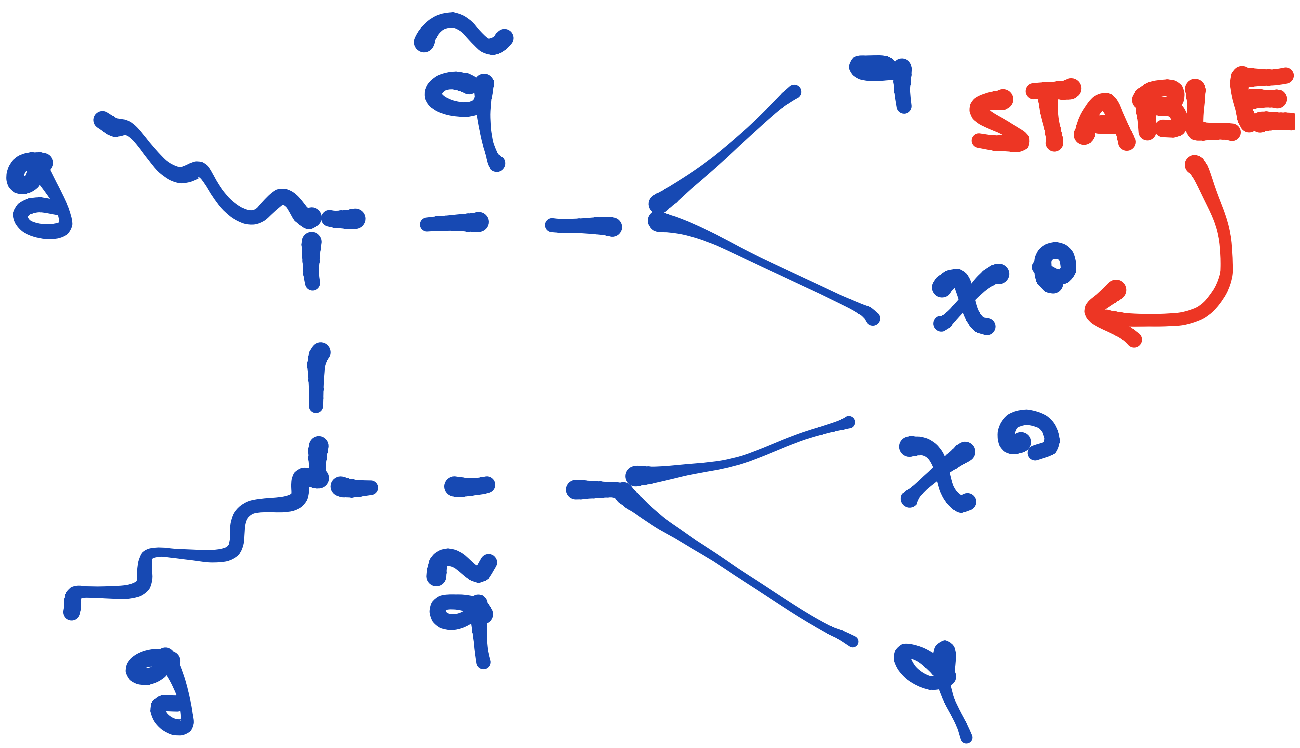
$$pp \rightarrow SUSY \rightarrow (\chi\chi) + SM$$

# Let it go ...

$$pp \to SUSY \to (\cancel{\text{[illegible]}}) + SM$$

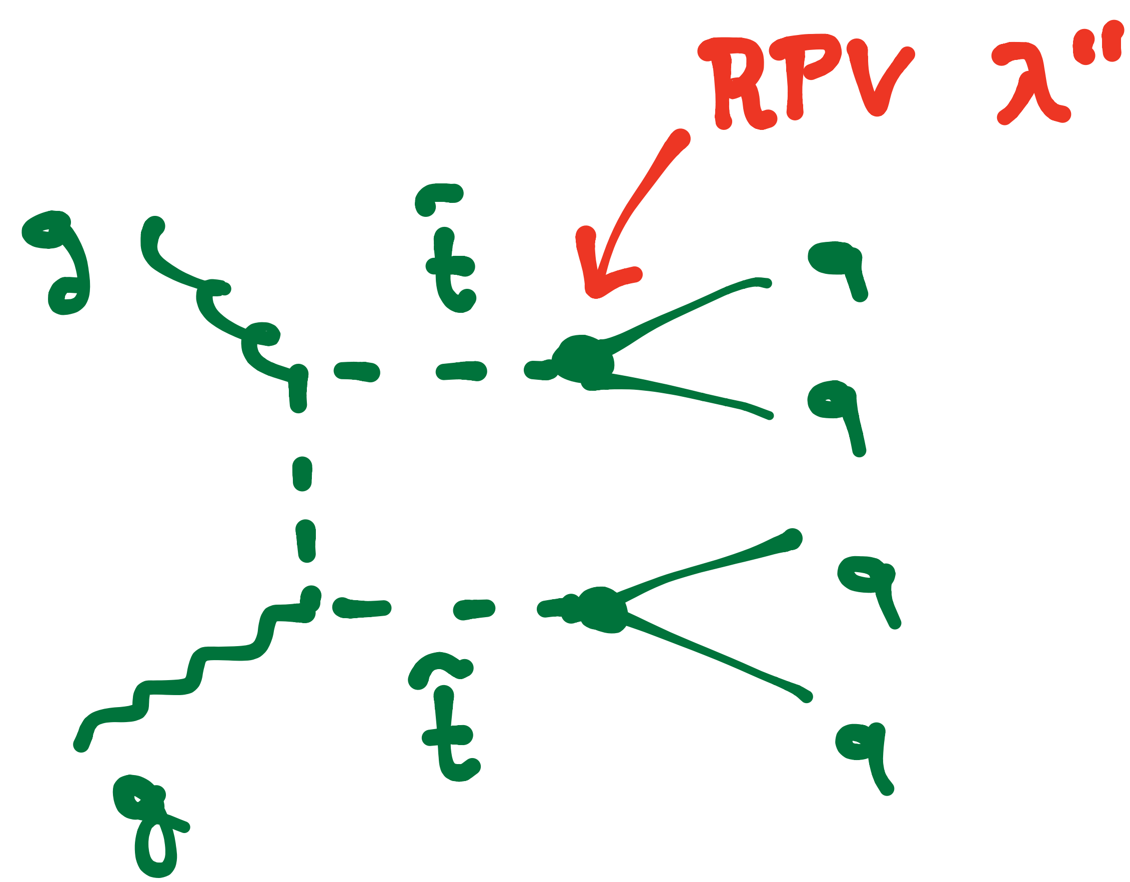
# Squark production

RPC




jet + mET

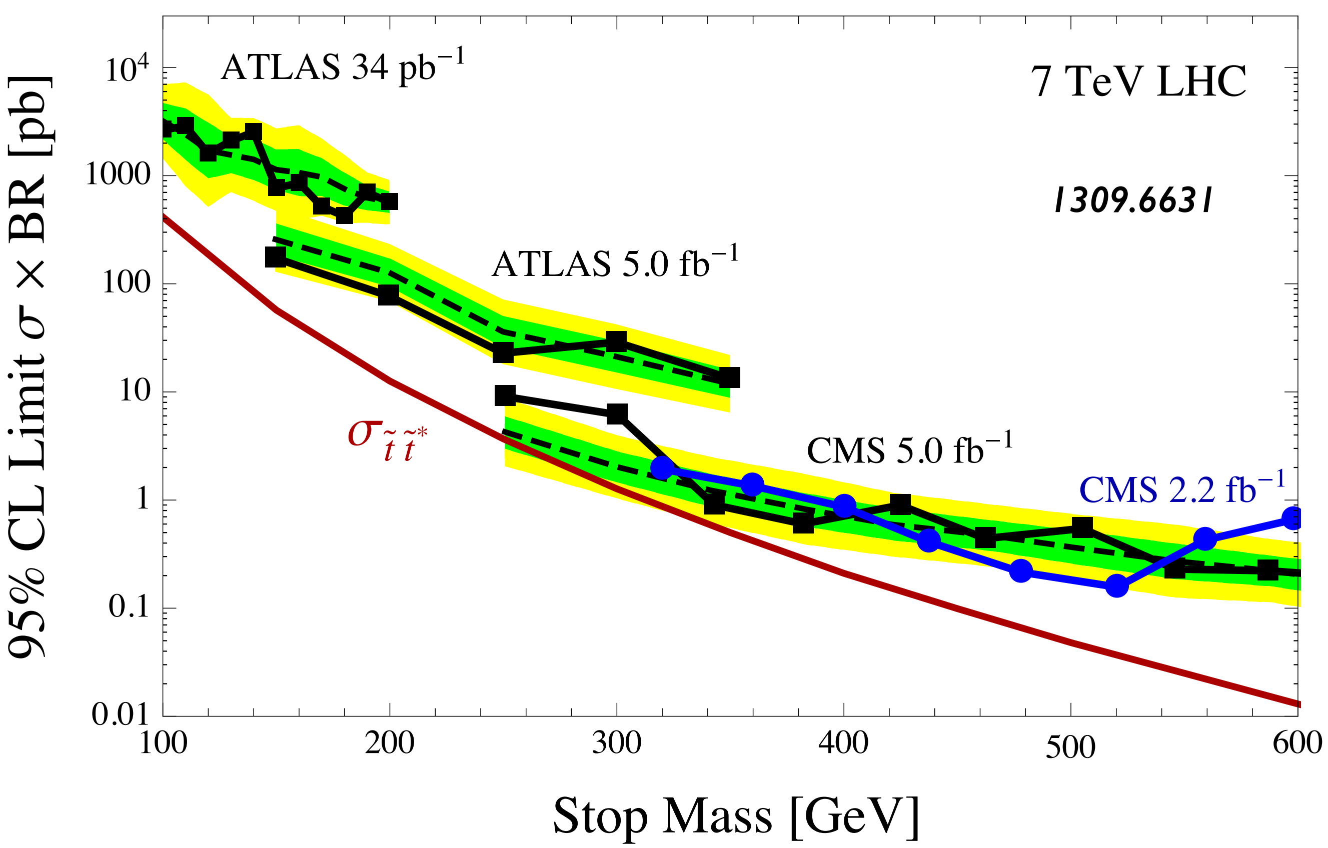
RPV

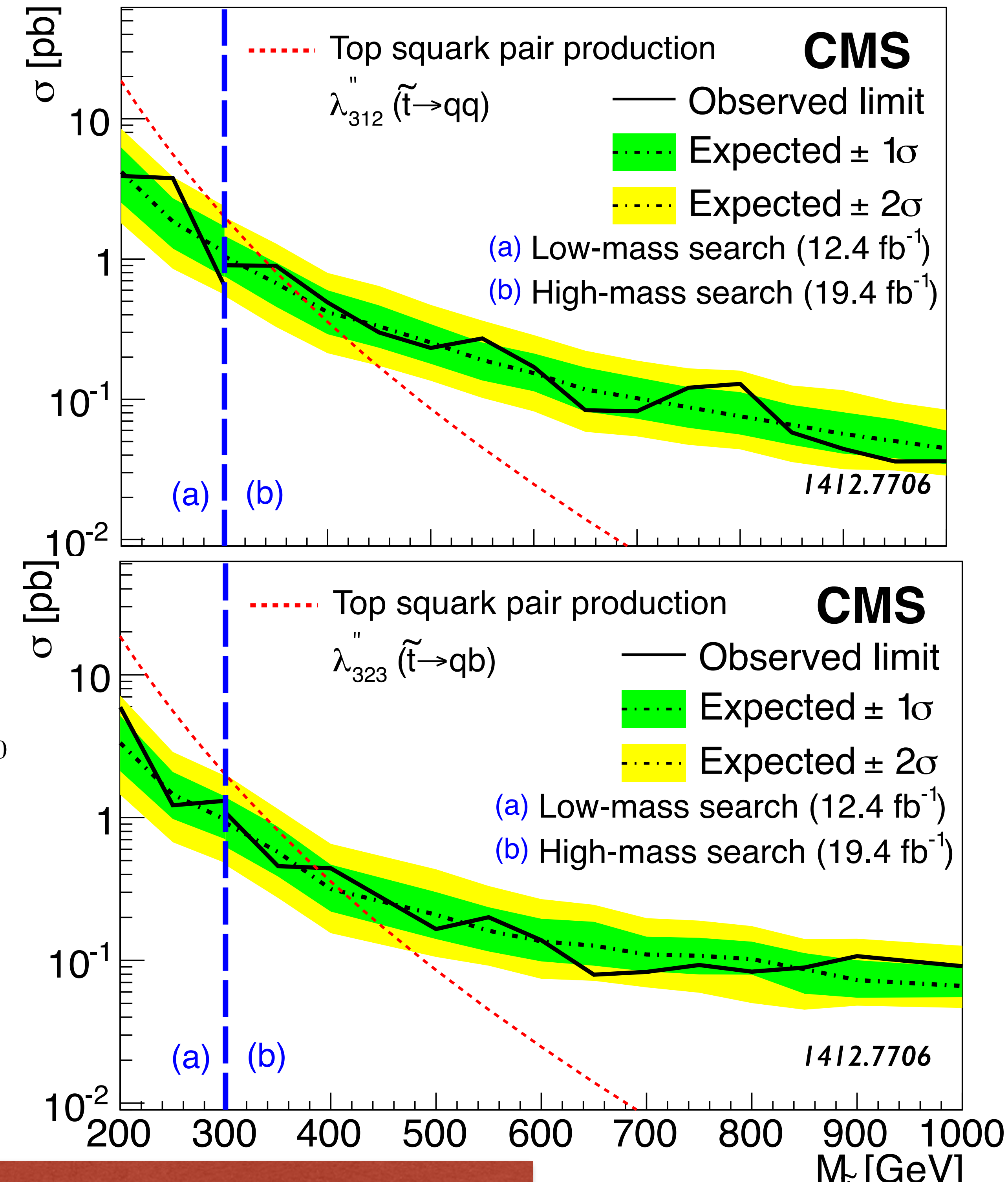



multi-jet

# Light is difficult $\tilde{t} \to jj$

signature relevant for many new physics scenarios

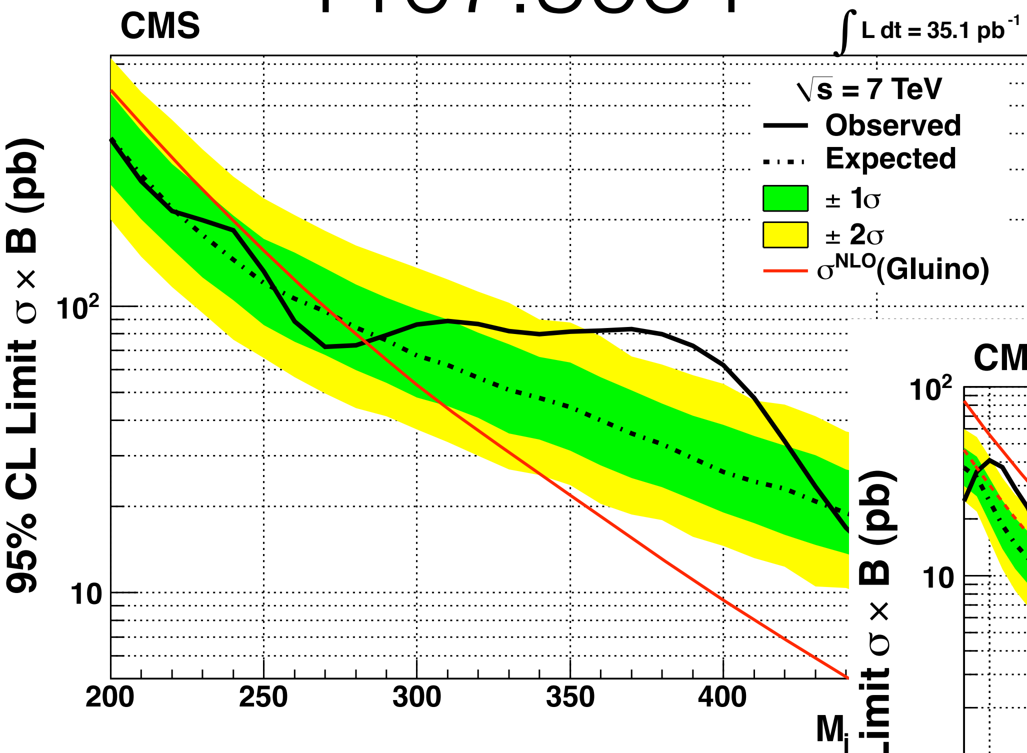


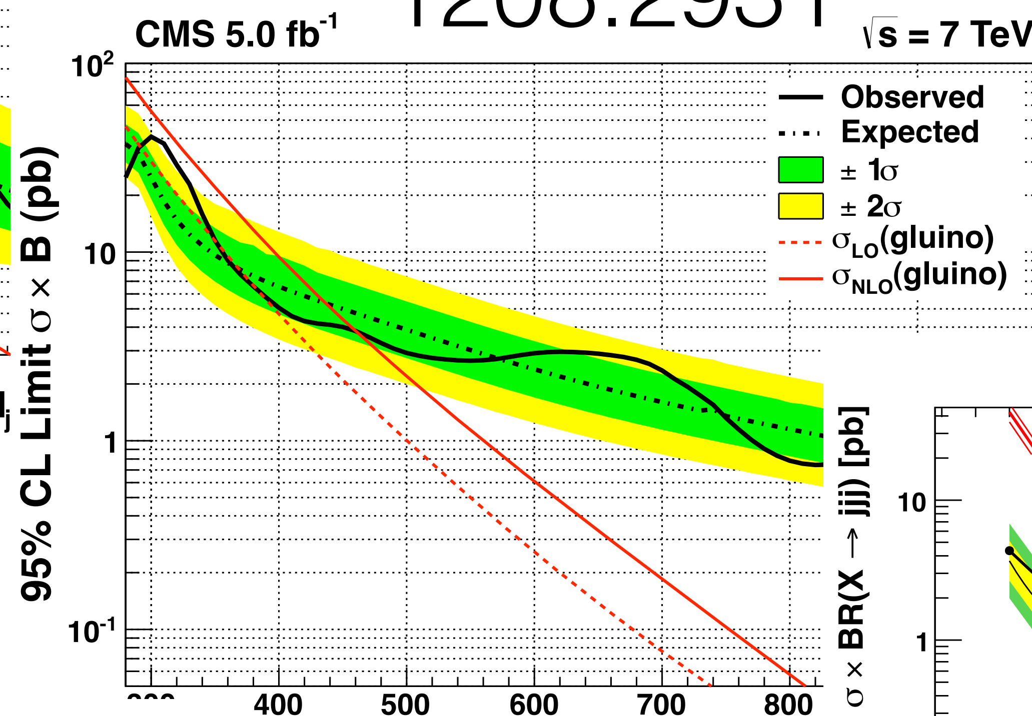

large gain by heavy-flavor tagging

# Light is difficult $\tilde{g} \to jjj$

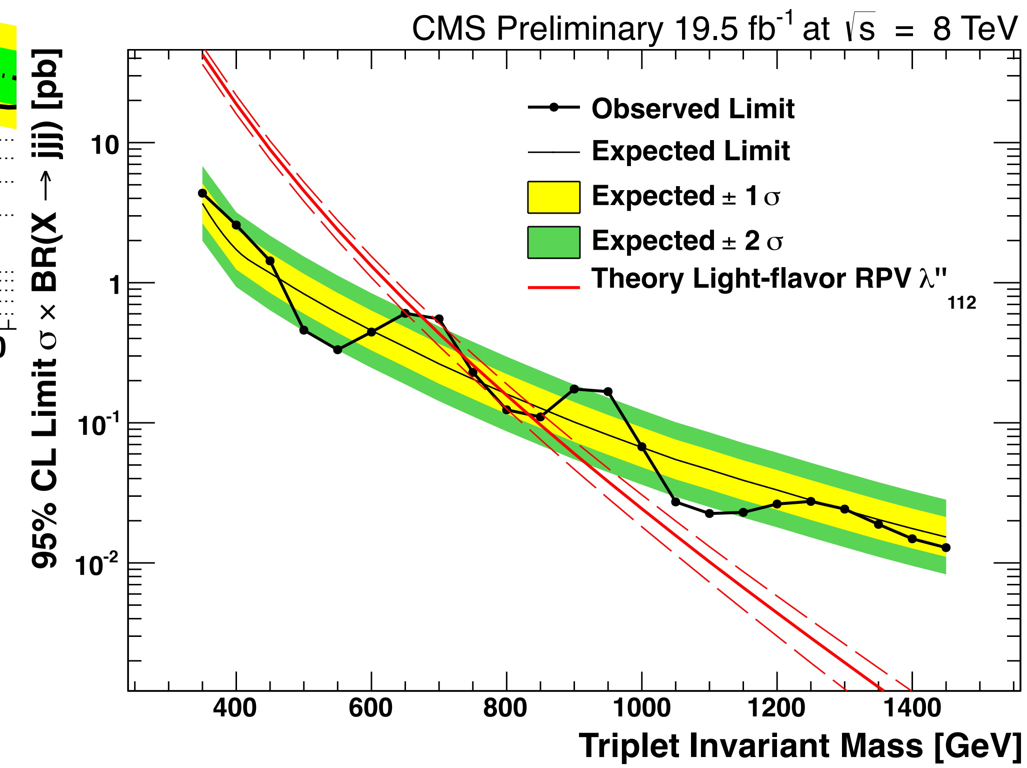
1107.3084

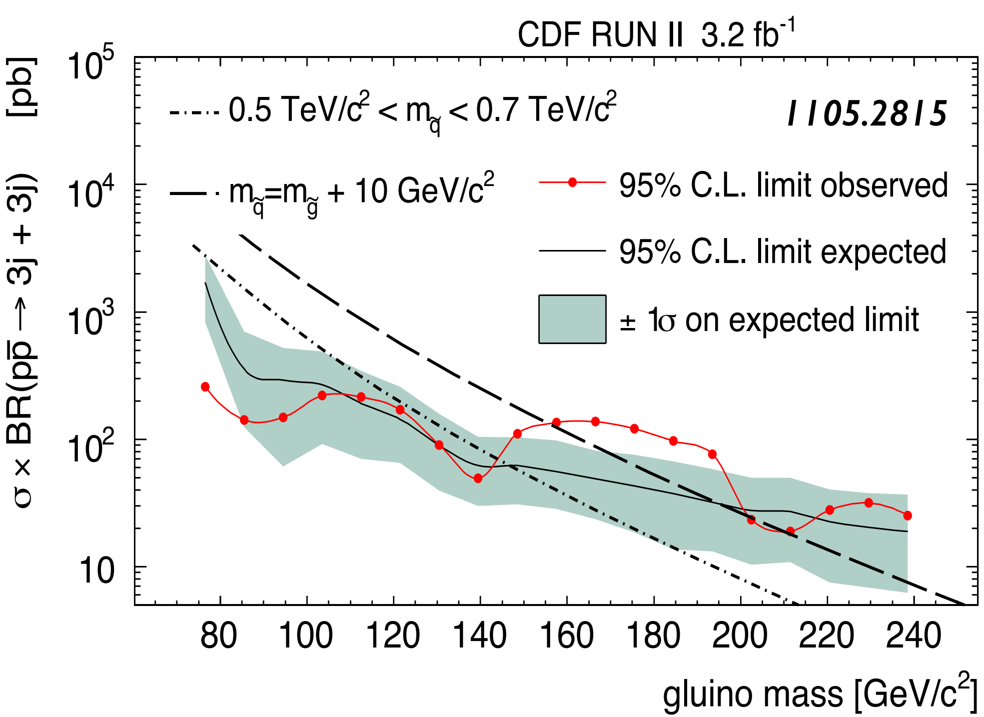



1208.2931




EXO-12-049

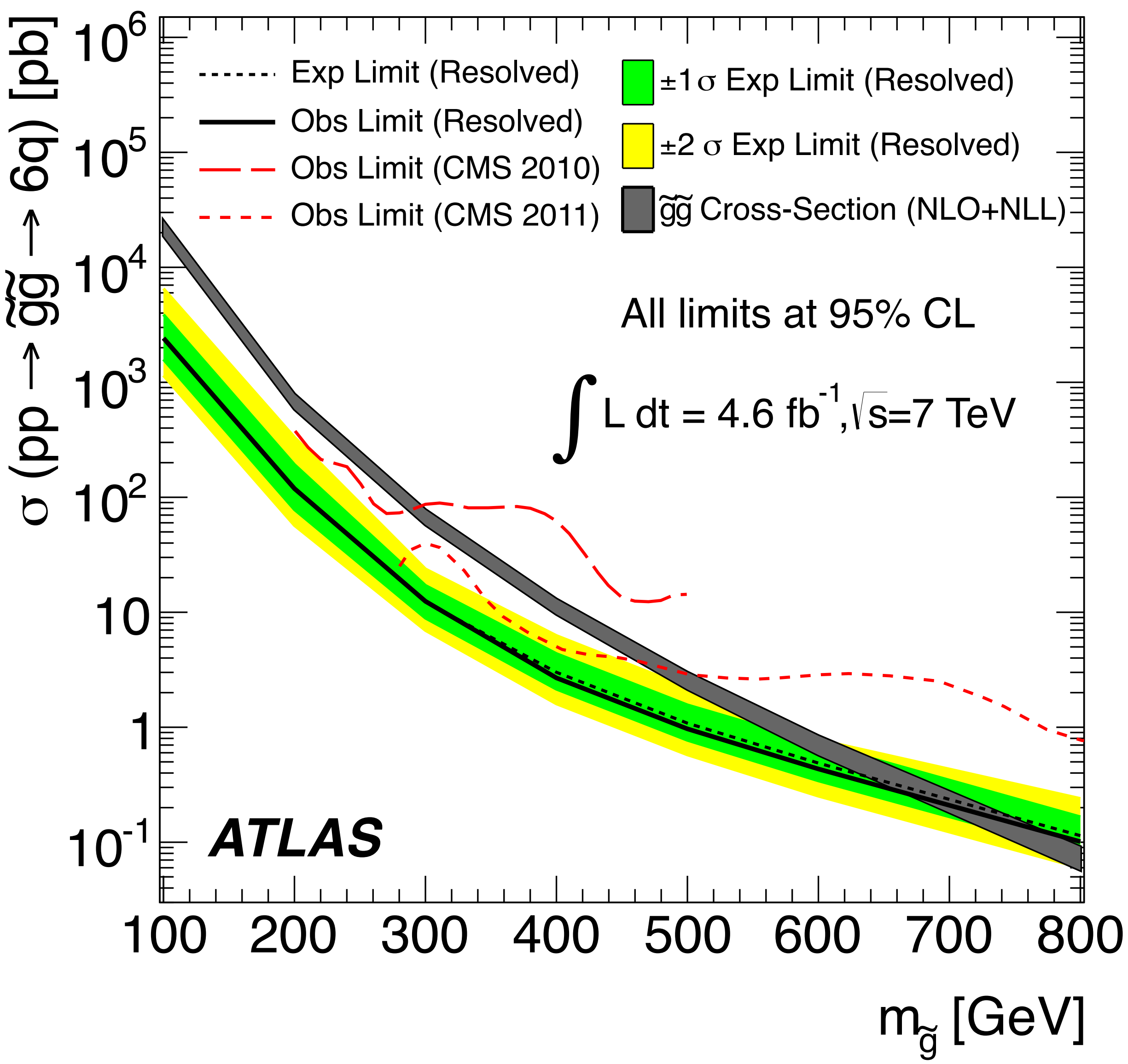


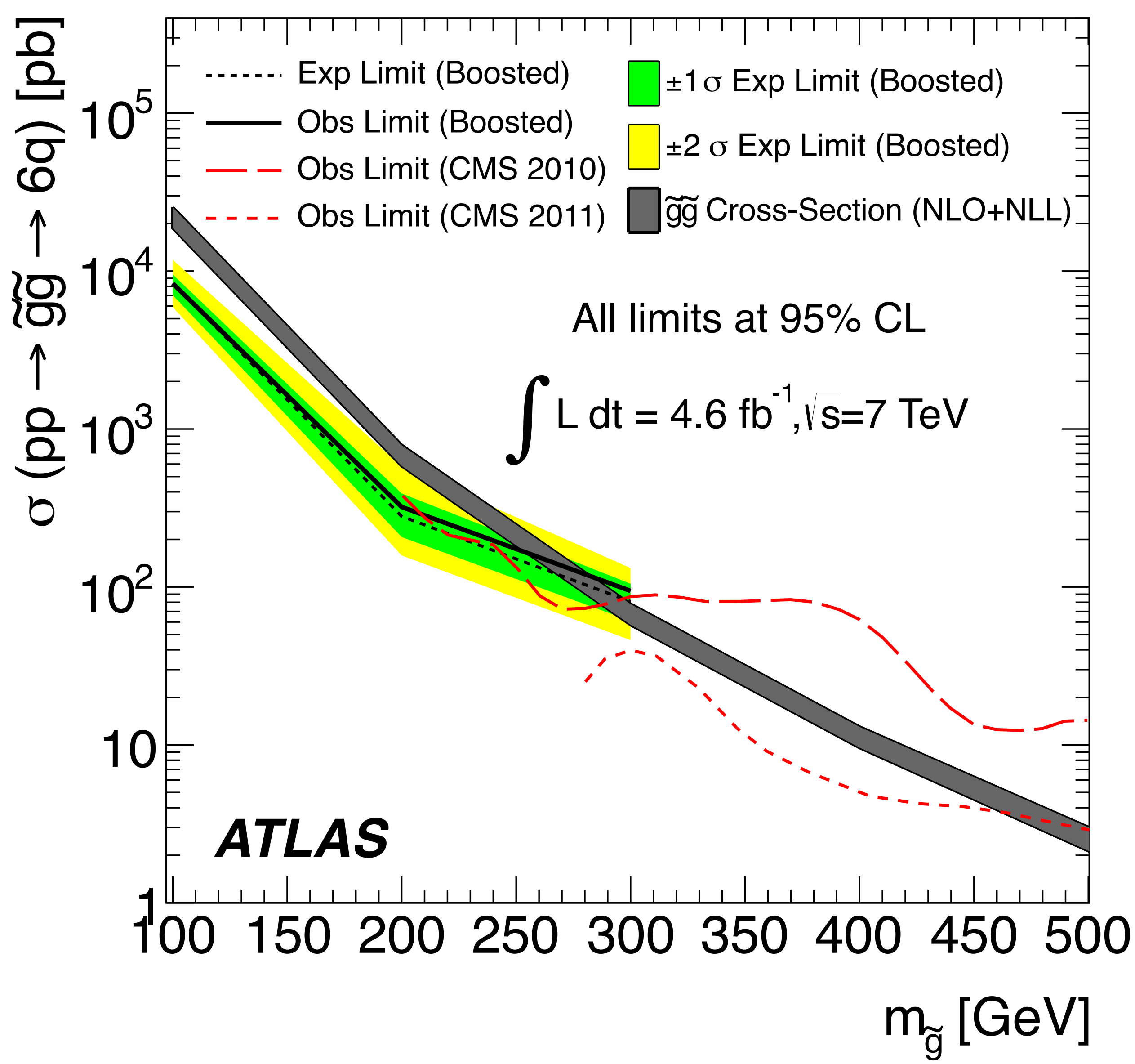
# proof of βoosted analyses for Run2

boosted analyses can be very inclusive

1210.4813




1210.4813

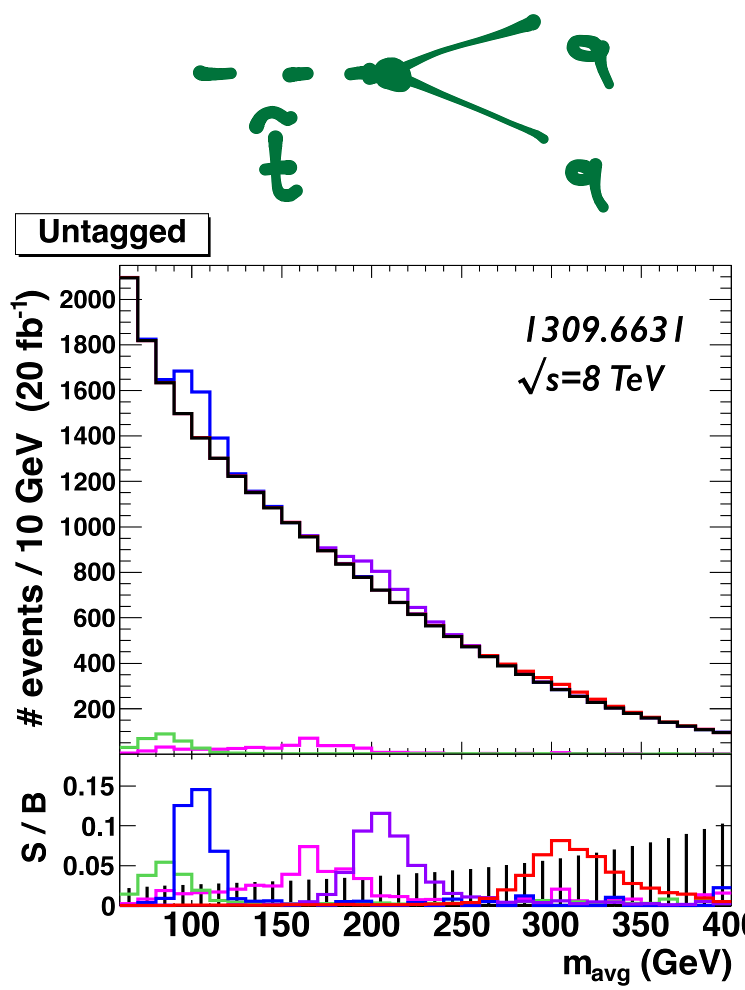


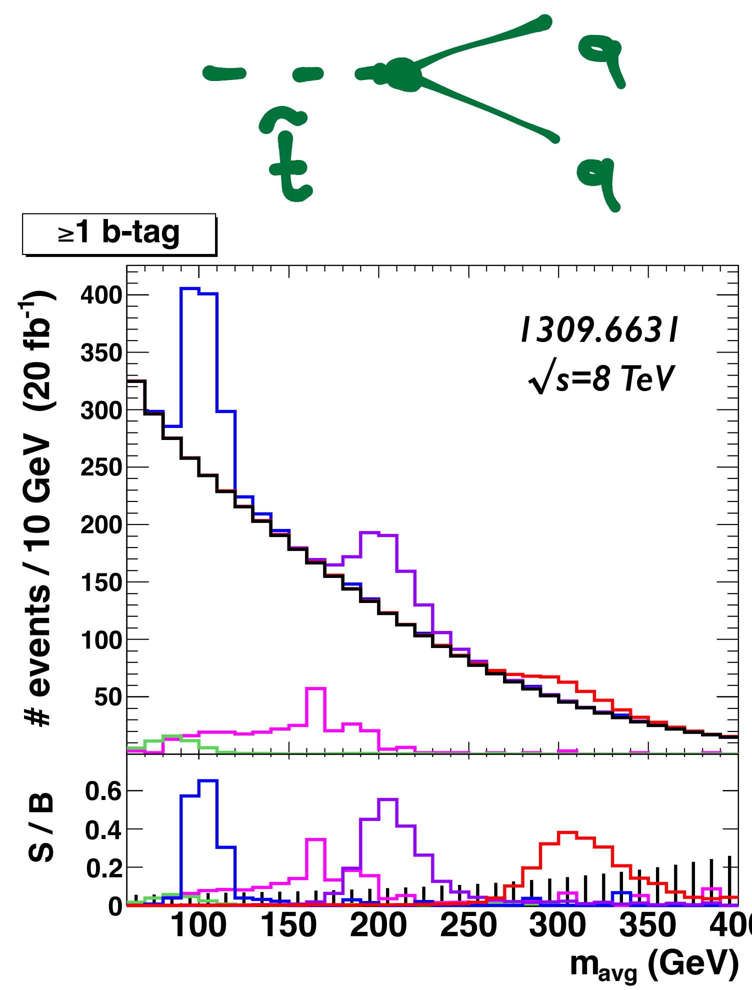

mounting importance (and power) of boosted analyses

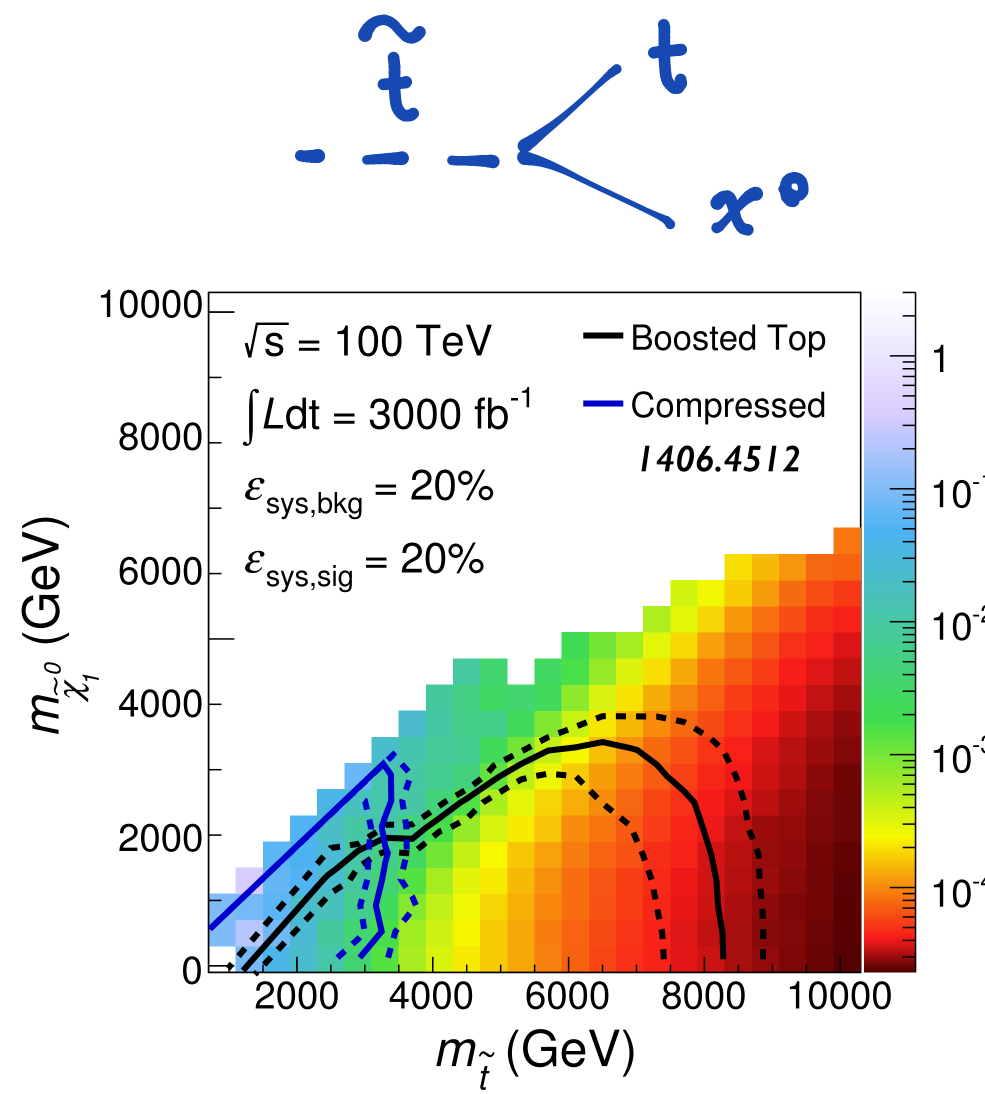
exclude well below the target model

# Boosted Regime at Run2

A few highlights to cover the low mass cases



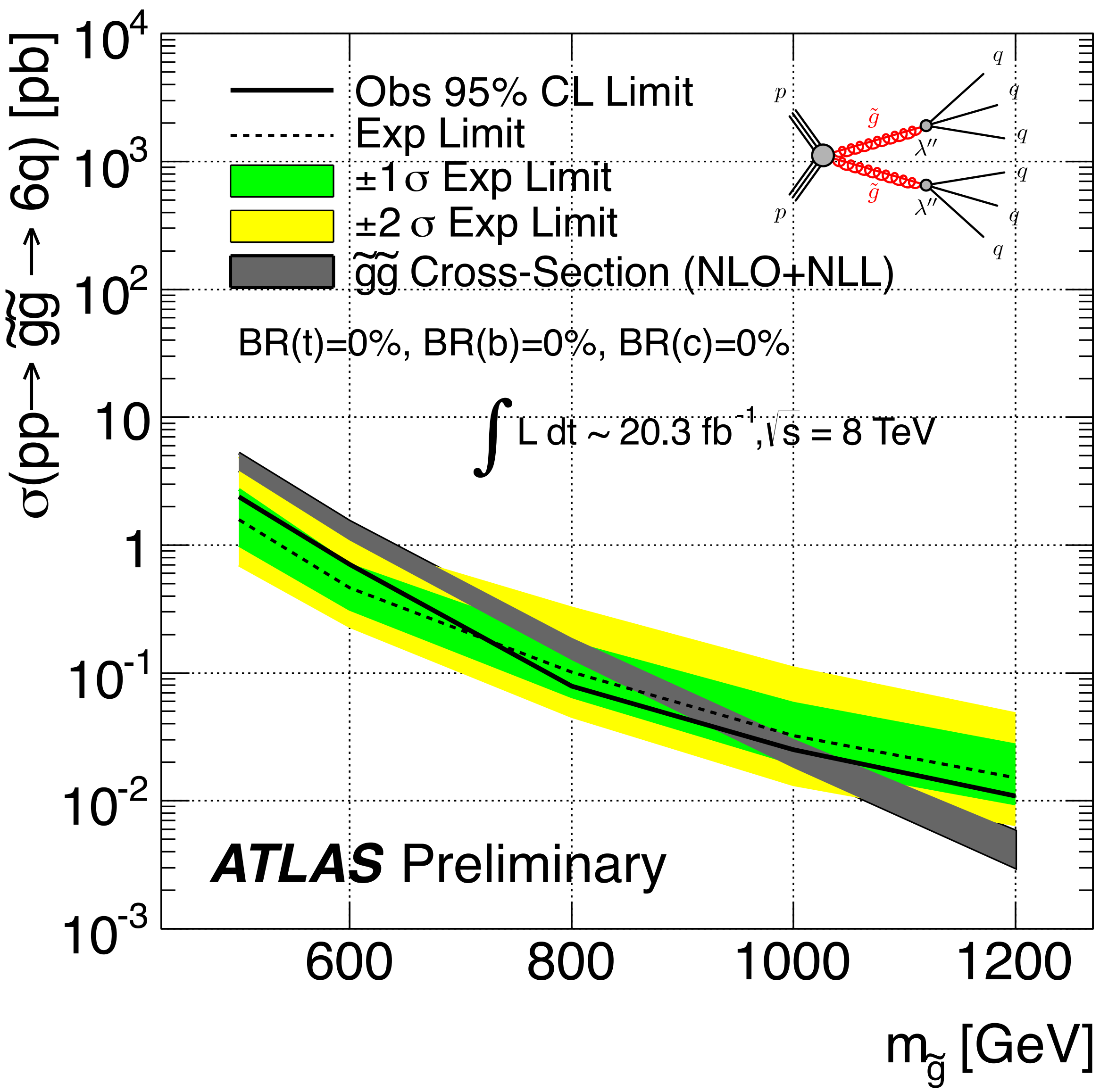



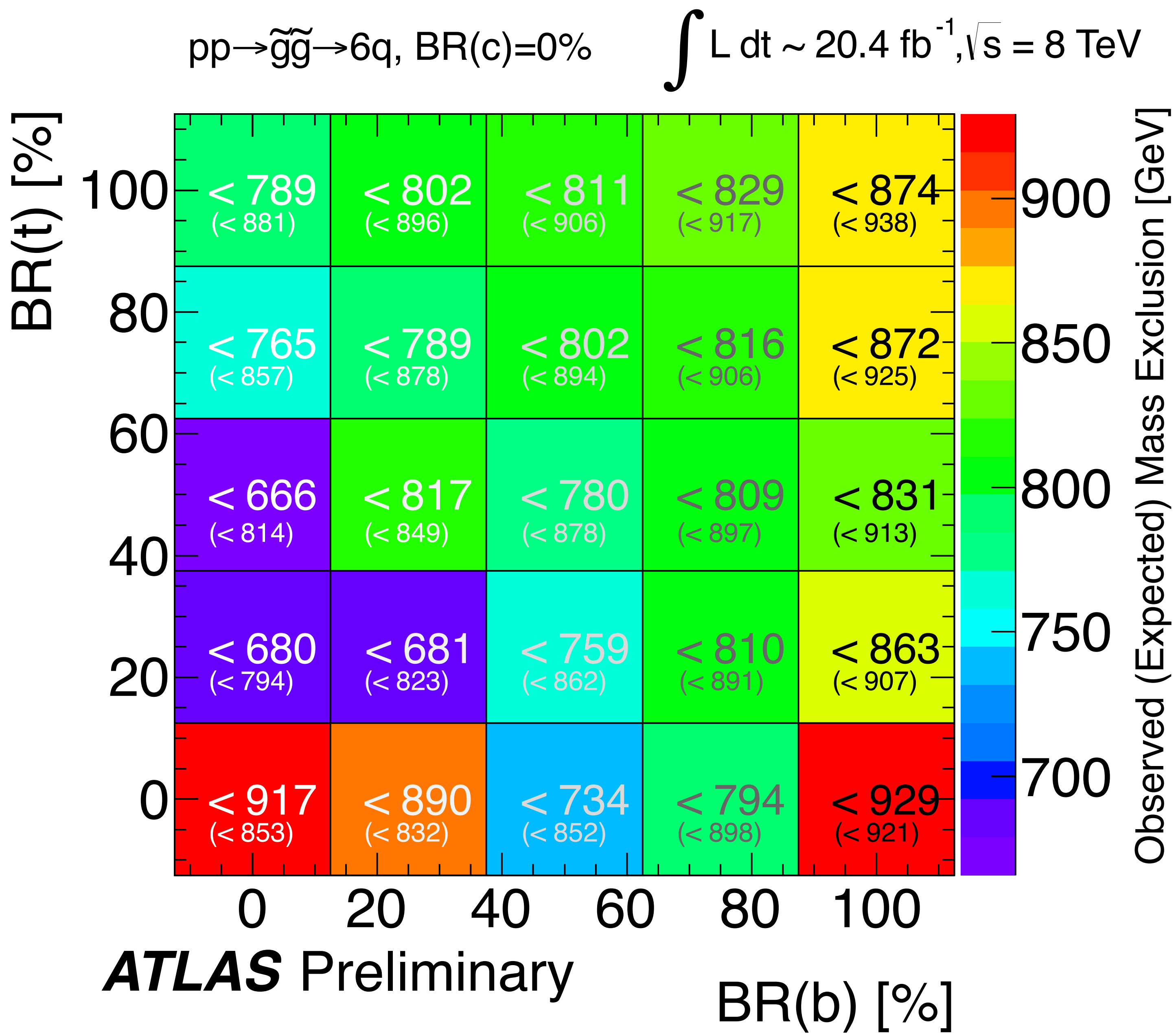




Lots of exotica
captured by this same signature

exclude well below the target model

# Heavy flavor tags at Run2



# Presentation of the results

goal is to make the results more long-lived

- Recast-friendly
- <u>Fully</u> reproducible
- largely digitized (HepData)

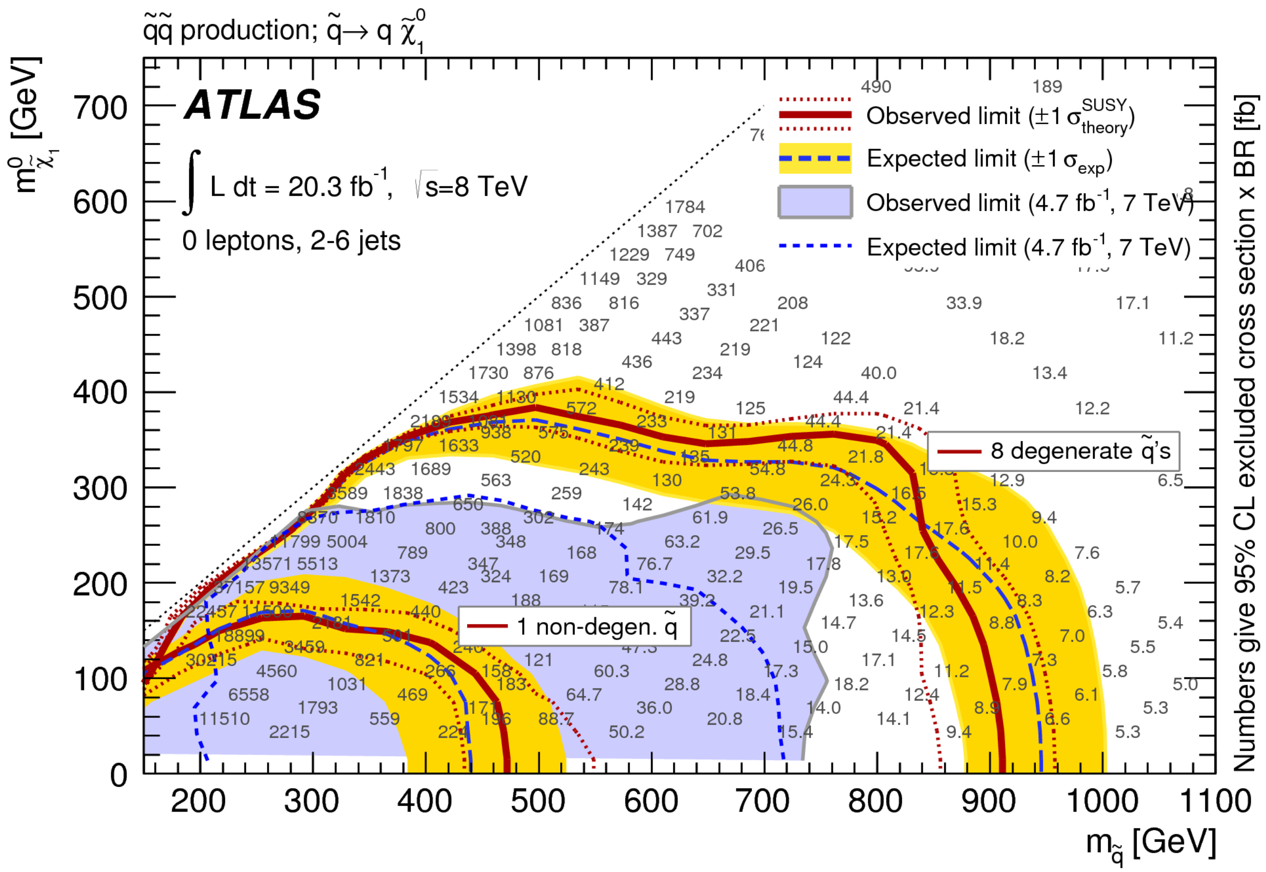
# Presentation of the results

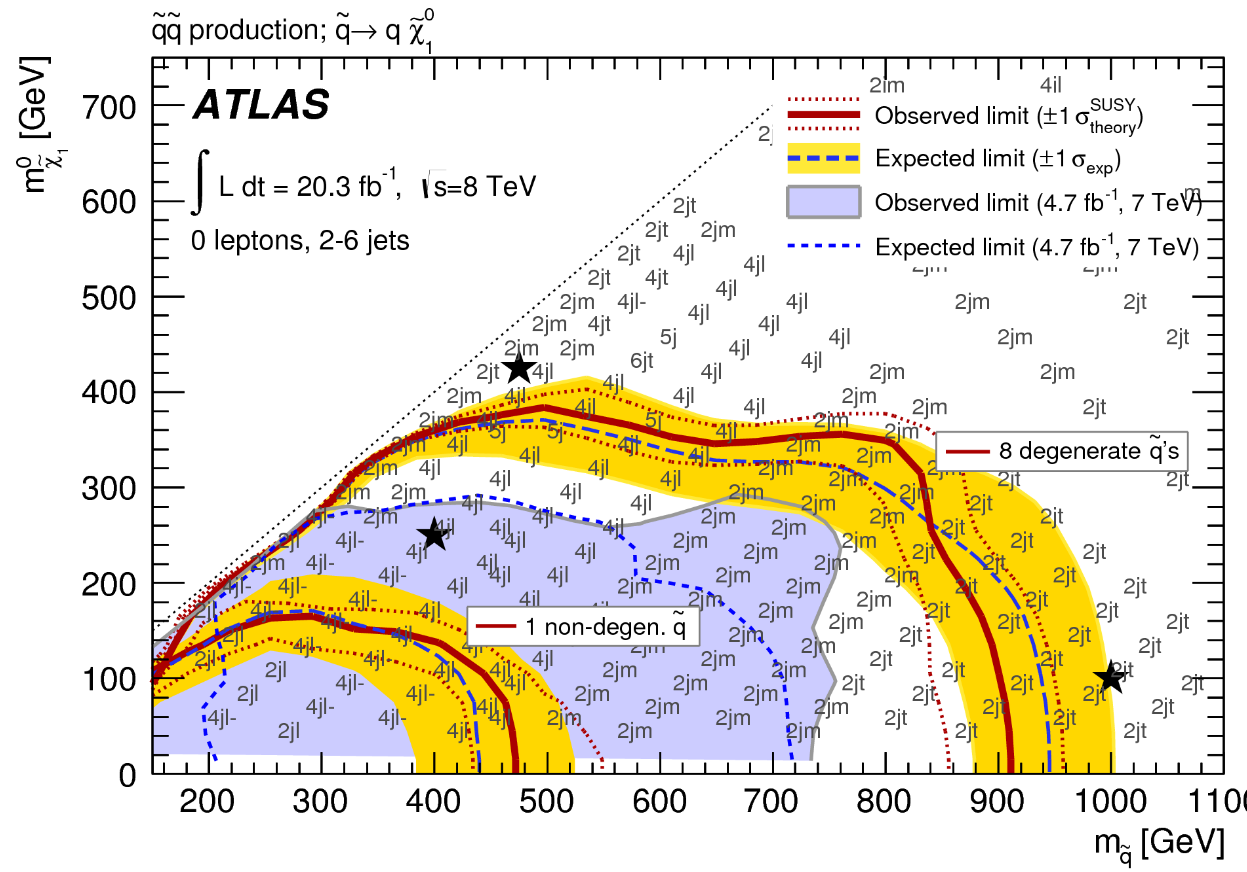
goal is to make the results more long-lived

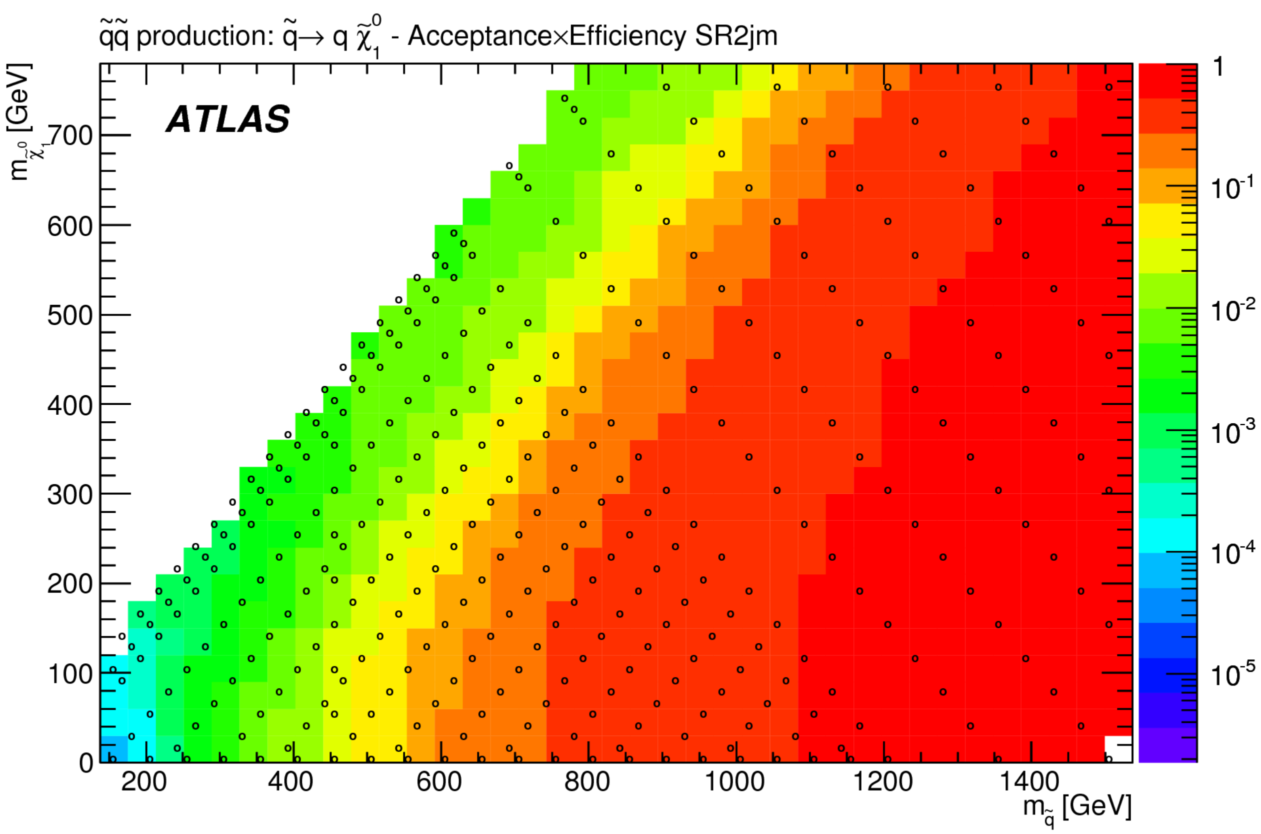
- Detailed Background efficiency and its <u>uncertainty</u>
- Detailed Signal efficiency and its <u>uncertainty</u>

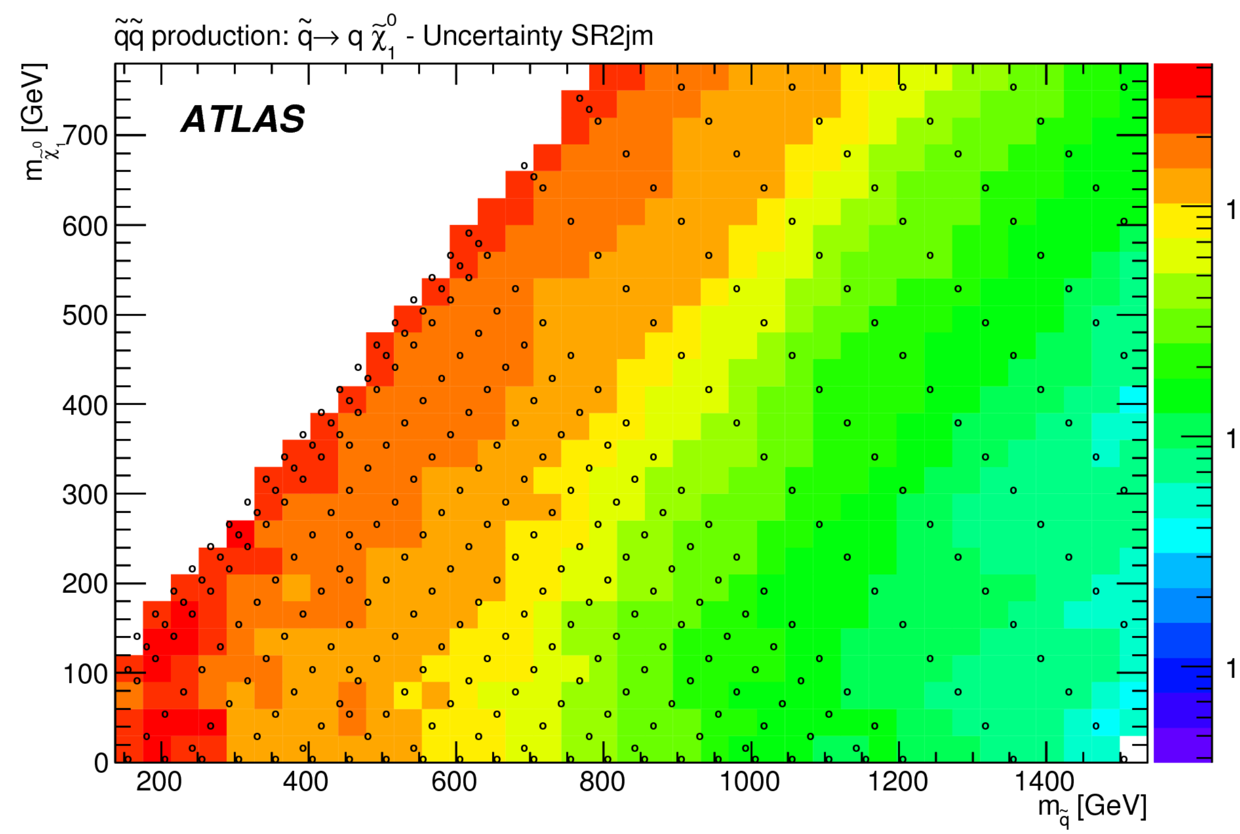
# Compressed Status

https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-02



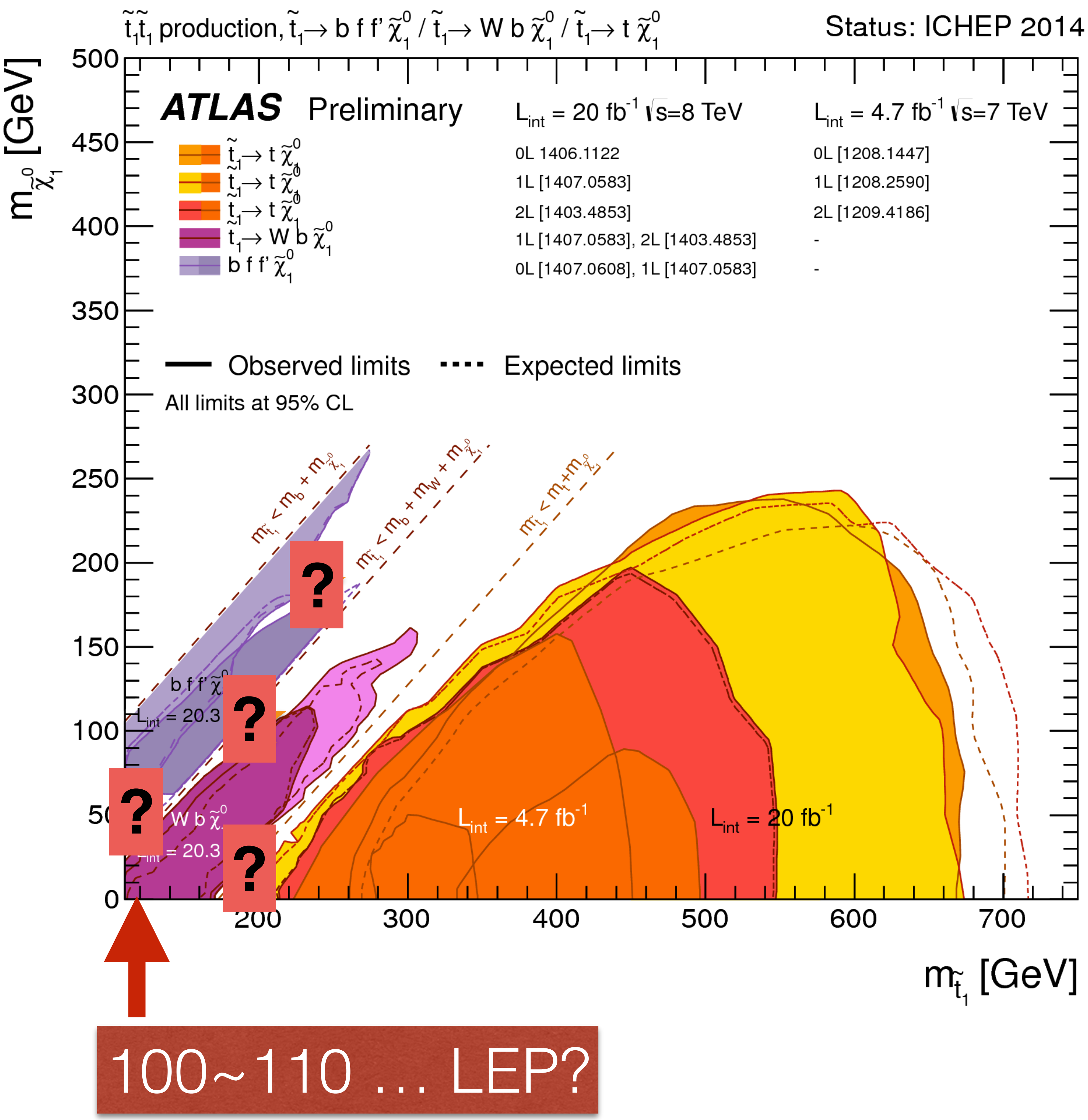



# Presentation of the results

goal is to make the results more long-lived

- Detailed Background efficiency and its **uncertainty**
- Detailed Signal efficiency and its **uncertainty**
- MCs have tons of parameters → **input cards**?
  (A, A×ε, … become much more useful)

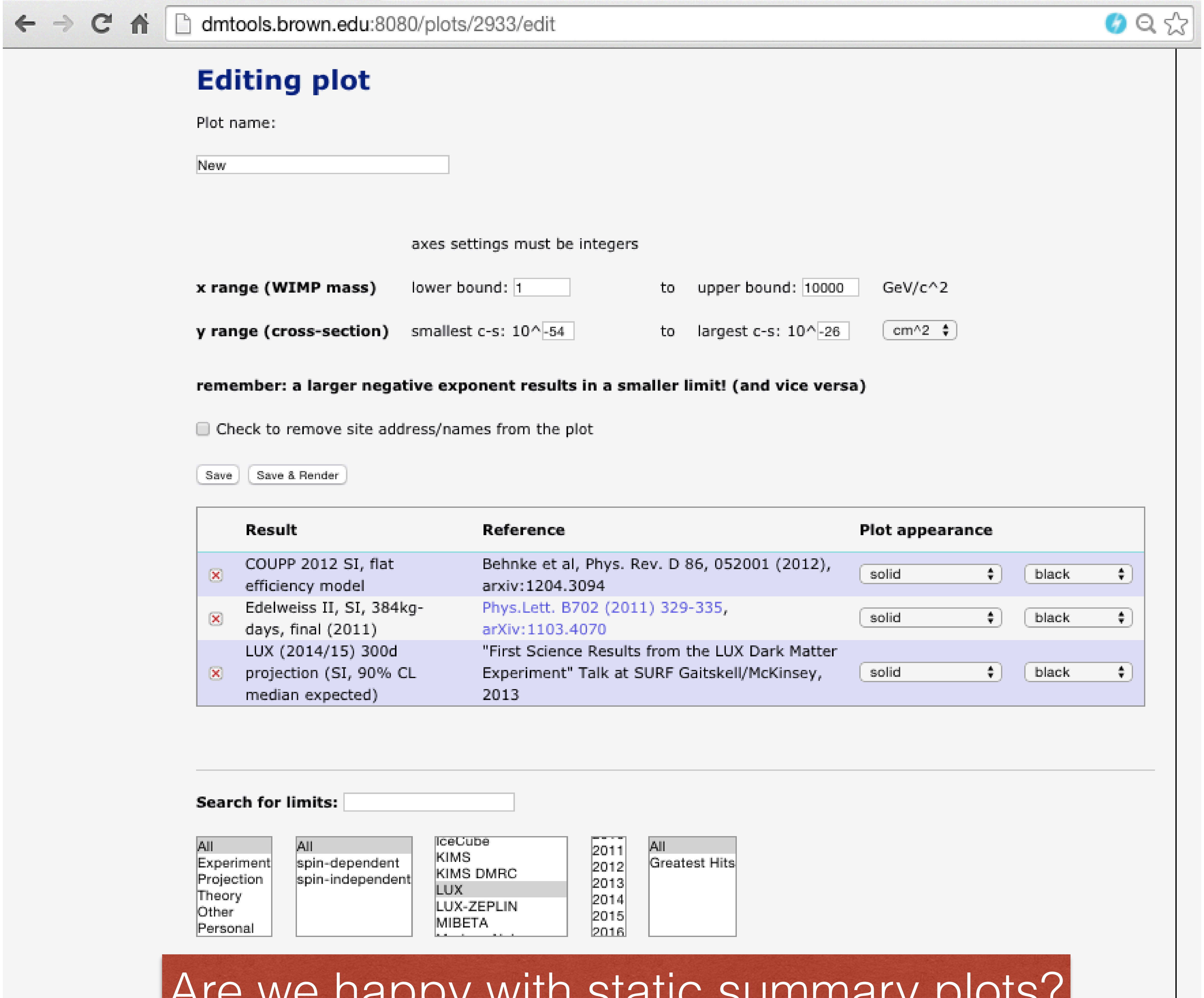
# Summary Plots




? signal uncertainty? → better tools for simulation

? background uncertainty? → better tools for simulation

? low acceptance? → better observable/SR




Are we happy with static summary plots?

# Conclusions

- **Simplified models** are still the way to go
- Colored landscape is actually black
- **Push on EW** (mono-X, stub-tracks and alike, soft leptons, …)
- **Heavy flavor, resonance tagging**
- **Precision SM** ↔ “low pT” BSM

# Conclusions (2)

how to **extend the life-time of the results**

In my opinion:

- signal and background simulation should be **fully reproducible** → publish cards for the codes? (truly gives meaning to publish A, A×ε, … )
- **exclude well beyond the "target model"**
- large body of results, mostly organized by Twiki (by hand?) (limited number of **static summary plots**?)
- more data on HEPDATA (for measurements and for searches)

# Extra

# SUSY ALTERNATIVES : DIRAC GLUINO

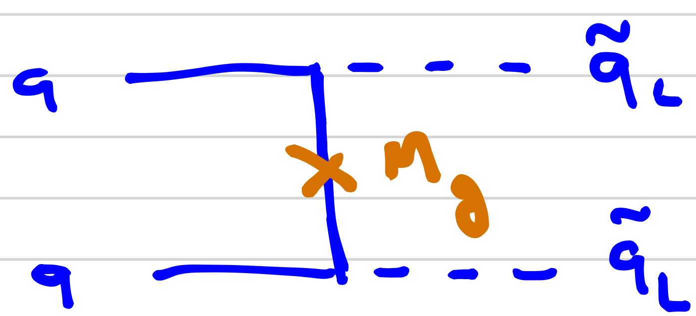
GIVE MASS TO THE GAUGINOS INTRODUCING $A_i$ DIRAC PARTNER

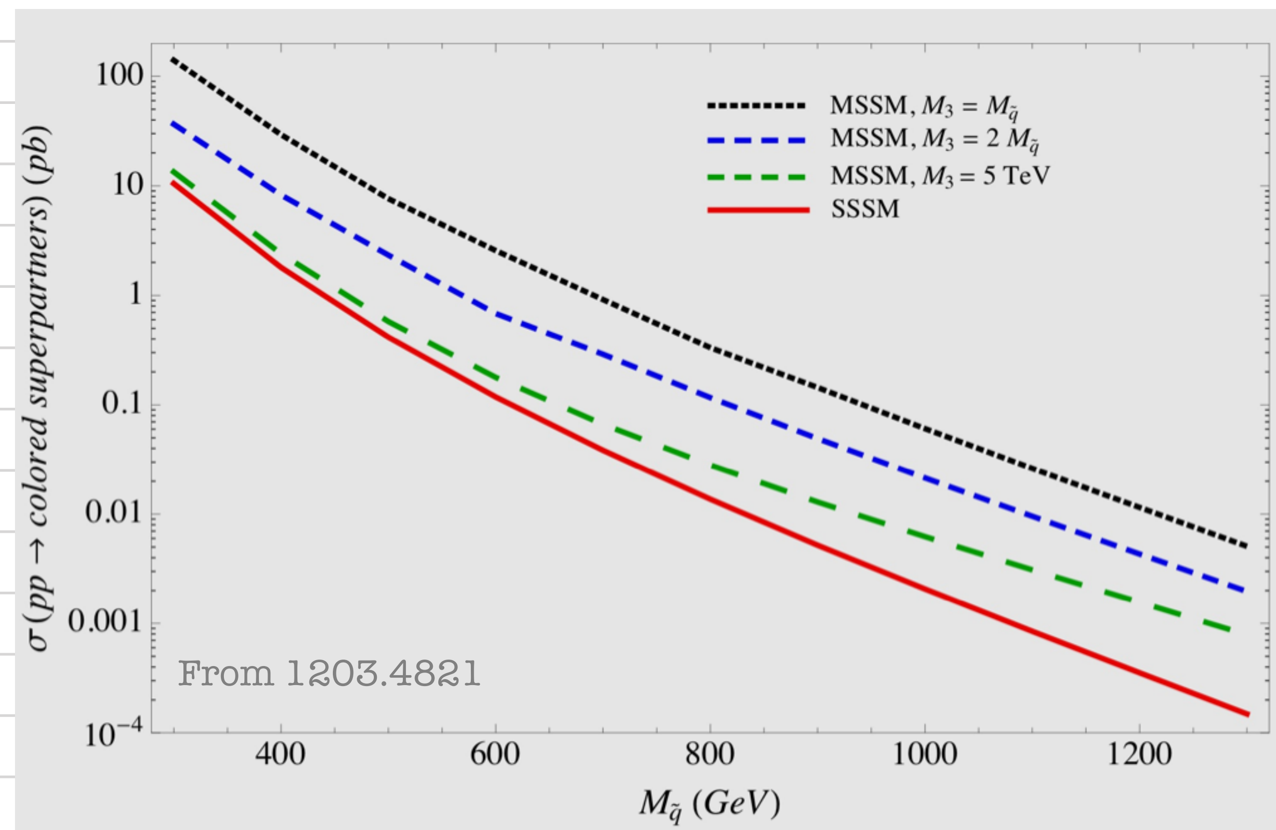
$$\int d^2\theta \, \frac{1}{M} A_i W'_{i,\alpha} W^\alpha \longrightarrow m_D A_i \tilde{\lambda}_i \qquad m_D \sim \frac{D}{M}$$

- DIRAC GLUINO

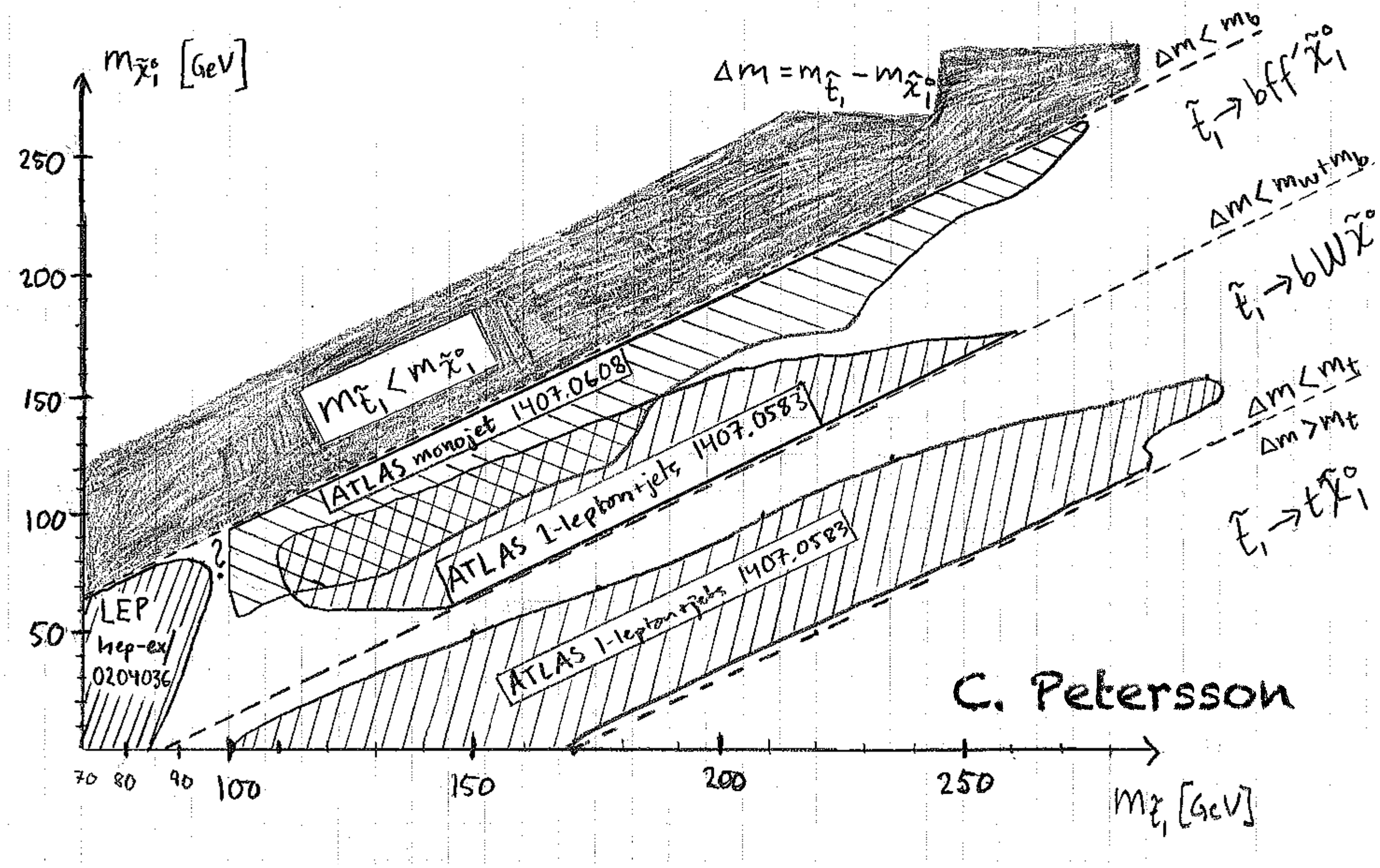
$pp \to \tilde{q}_L \tilde{q}_L \,,\, \tilde{q}_R \tilde{q}_R \,,\, \tilde{q}_L \tilde{q}_R$

AT HIGH $m_{\tilde{q}}$ $\quad qq \to \tilde{q}\tilde{q}$

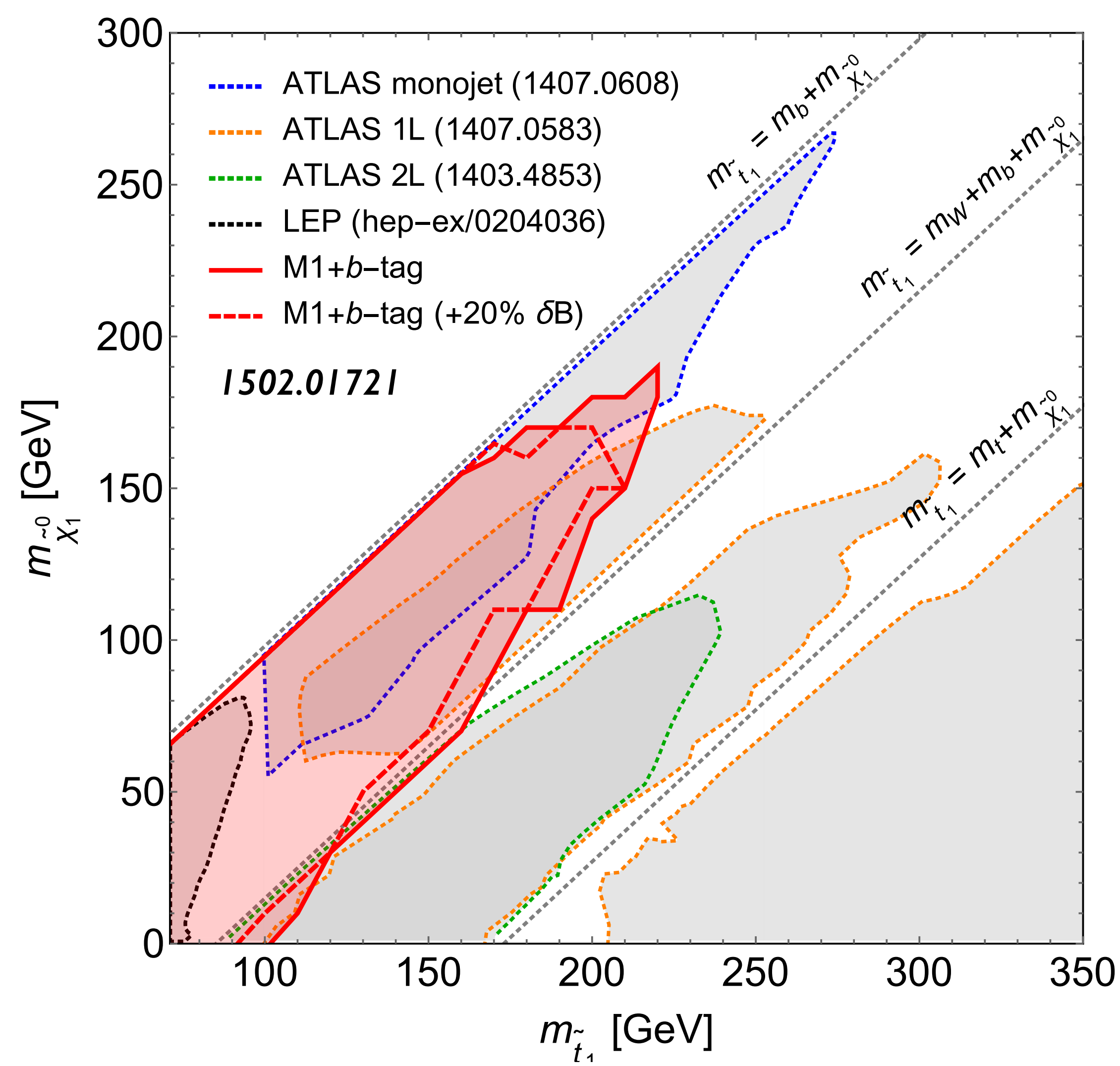


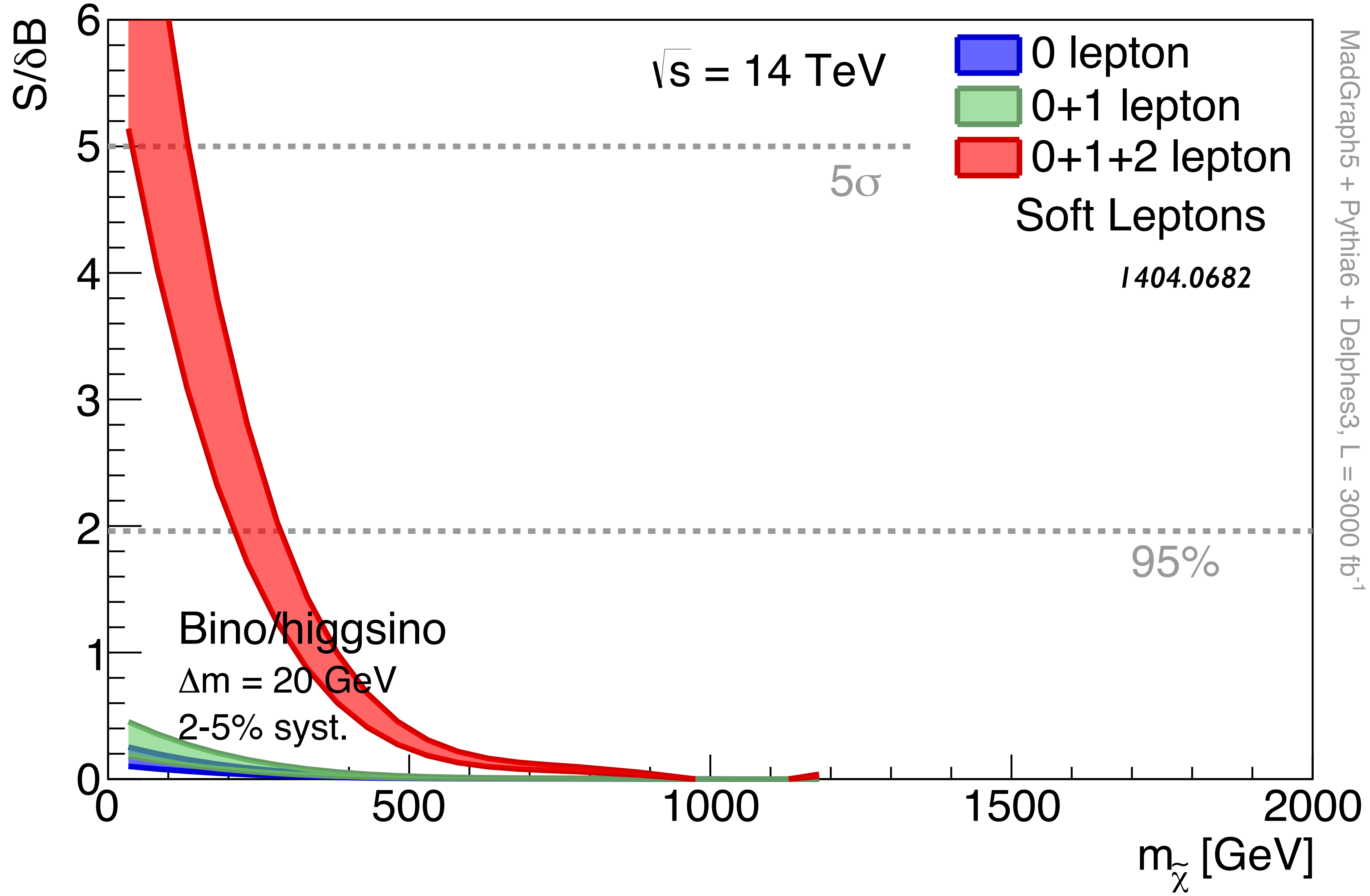

GAUGINO PARTNERS PHENOMENOLOGY $\qquad A_3 \longrightarrow jj$



$m_{\tilde{\chi}_1^0}$ [GeV]
$\Delta m = m_{\tilde{t}_1} - m_{\tilde{\chi}_1^0}$
$\Delta m < m_b$
$\tilde{t}_1 \to bff'\tilde{\chi}_1^0$
$\Delta m < m_W + m_b$
$\tilde{t}_1 \to bW\tilde{\chi}^0$
$\Delta m < m_t$
$\Delta m > m_t$
$\tilde{t}_1 \to t\tilde{\chi}_1^0$
$m_{\tilde{t}_1} < m_{\tilde{\chi}_1^0}$
ATLAS monojet 1407.0608
ATLAS 1-lepton+jets 1407.0583
ATLAS 1-lepton+jets 1407.0583
LEP hep-ex/0204036
C. Petersson
$m_{\tilde{t}_1}$ [GeV]



ATLAS monojet (1407.0608)
ATLAS 1L (1407.0583)
ATLAS 2L (1403.4853)
LEP (hep-ex/0204036)
M1+b–tag
M1+b–tag (+20% δB)
1502.01721
$m_{\tilde{t}_1} = m_b + m_{\tilde{\chi}_1^0}$
$m_{\tilde{t}_1} = m_W + m_b + m_{\tilde{\chi}_1^0}$
$m_{\tilde{t}_1} = m_t + m_{\tilde{\chi}_1^0}$
$m_{\tilde{\chi}_1^0}$ [GeV]
$m_{\tilde{t}_1}$ [GeV]



S/δB
√s = 14 TeV
0 lepton
0+1 lepton
0+1+2 lepton
Soft Leptons
1404.0682
5σ
95%
Bino/higgsino
Δm = 20 GeV
2-5% syst.
m_χ̃ [GeV]
MadGraph5 + Pythia6 + Delphes3, L = 3000 fb-1
0
1
2
3
4
5
6
0
500
1000
1500
2000